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ABSTRACT

This study on the use of telecommunications to improve access to the specialized information needed for development was conducted by a national team and carried out through a series of meetings in Jakarta and Bandung. Persons contacted included Indonesian officials responsible for national development in information and telecommunications, actual and potential major users of data communications, and officials of two regional organizations. A general discussion of the Indonesian situation is followed by a review of current data communication technology, including computer networks, data networks, and ISDN (integrated services digital networks); packet switched data networks; satellite communication; the SATNET experiment; and tele-informatics services. The existing Indonesian telecommunications network is described as well as the development of national telecommunications services, PACKSATNET, and international facilities and regional cooperation. Specialized, organizational, and general information services and needs are discussed, and national strategy options are examined with a look at development strategy for a National Packet Switching Network (NPSN), telecommunications technology for the NPSN, improvement of access to PACKSATNET through PSTN (public switched telephone network) connections, international data connections, Telex aspects, operational aspects and maintenance, databases and computer facilities, tele-informatics services, and investments. International strategy options are also addressed. Conclusions and recommendations cover national policy, regional and international cooperation, marketing and tariff strategy/user awareness, investments, human resources, standards/local manufacture of equipment, and research and development. Twenty-eight references, eight appendices, and sixteen figures are included. (LMM)

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Paris, January 1984

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TELECOMMUNICATION SERVICES FOR THE TRANSFER OF INFORMATION AND DATA : A CASE STUDY IN INDONESIA

Prepared by
Daniel Pierre Battu
and
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PREFACE

In recent years information has increasingly been considered as a major commodity, and as a valuable national resource, and information transfer has become a major field of activity. Due to recent developments in telecommunications and computer technologies, sophisticated on-line information services in most fields of knowledge are already widely available in the developed countries, but potential users in the developing countries still do not generally have access to such data banks.

In view of the importance accorded by Member States to improving access to the specialized information needed for development and the need to improve understanding of this problem by the information, informatics and telecommunications community, studies on the use of telecommunications for information transfer were foreseen within the Unesco Regular Programme for 1981-83, in cooperation with the International Telecommunication Union (ITU). The present document is based on the results of the first study of this type, which was undertaken from 25 January 1982 to 6 February 1982 with the collaboration of the Indonesian Government by a mission consisting of a Unesco consultant (Mr. D.P. Battu, Director of the EURONET Project Team*, Commission of the European Communities) and a Unesco staff member (Mr. John P. Rose).

The terms of reference of the mission foresaw the undertaking of an analysis of:

- the present situation in Indonesia with respect to telecommunications facilities appropriate for national and international data communication applications, with particular reference to information transfer and retrieval;

- the present and potential demand for national and international data communications, with particular emphasis on information transfer and retrieval applications;

- plans, possibilities and obstacles relating to development of public data communications channels, including use of the general switched telephone and telex networks, leased lines and public data networks; and

- the potential impact of public tele-informatics services such as teletex, facsimile and videotex;

as well as the formulation of recommendations on the improvement of information transfer covering:

- a model for linking information sources and user organizations at the national level by existing and future telecommunications facilities;

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* EURONET is an international public data network sponsored by the telecommunications administrations of the ten countries of the European Economic Community and Switzerland, as well as by the Commission of the European Communities.

- priority areas for concentration of effort at the national level;

- implications for investment, with particular consideration of hardware and software requirements; and

- options for regional and international cooperation in developing the use of data communications, and in linking existing networks.

The Indonesian Government named a national team consisting of representatives from the Ministry of Information, the Directorate General of Posts and Telecommunications and the National Commission for Unesco to organize and participate in the study which was carried out through a series of meetings and interviews in Jakarta and Bandung. The persons contacted (see the schedule, Appendix 1) included officials responsible for national development in the areas of information and telecommunications, actual and potential major users of data communications, as well as officials of two regional organizations. Subsequently, one member of the mission (Mr. Pattu) contacted several experts in London to discuss questions raised in Indonesia on the application of satellite communication techniques for data transfer. The Unesco team also visited the International Telecommunication Union in Geneva for briefing prior to the mission, and consulted with the concerned ITU units on the results of the study in draft form. Finally, a number of very useful suggestions on the draft study were received from the Indonesian Telecommunications Administration (PERUMTEL), particularly concerning the PACKSATNET project, and from the Indonesian Ministry of Information; these suggestions have been incorporated into the present document.

The technical conclusions of the mission concerning telecommunications are nevertheless the responsibility of the member of the team (Mr. Pattu) who is a specialist in this field. In particular, ITU has not been involved in developing the proposals on telecommunications technologies for the transfer of information and data which, although based on study of the situation in Indonesia in early 1982, are formulated, unless otherwise specified, for the consideration of policy makers and specialists concerned with this problem in developing countries in general.

Readers' comments on this document, particularly concerning its relevance to problems in their own countries or regions, would be most welcome. Such comments, as well as requests for copies of the document, should be addressed to:

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75700 Paris
France

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I. The Indonesian situation - general considerations

Indonesia is an insular country including 13,677 islands of which 3000 are inhabited. It is spread over a distance of 5150 km from East to West and has a surface area of 1,932,350 sq.km. The largest islands (see map, figure 1) are Kalimantan (formerly Borneo), Sumatra, Irian Jaya (Western New Guinea), Sulawesi (formerly Celebes) and Java. The population of Indonesia was more than 147 million in 1980, making it the fifth largest country in the world. More than 60% of the population is concentrated on the fertile island of Java, which contains the three largest cities including the capital of Jakarta (6.5 million inhabitants).

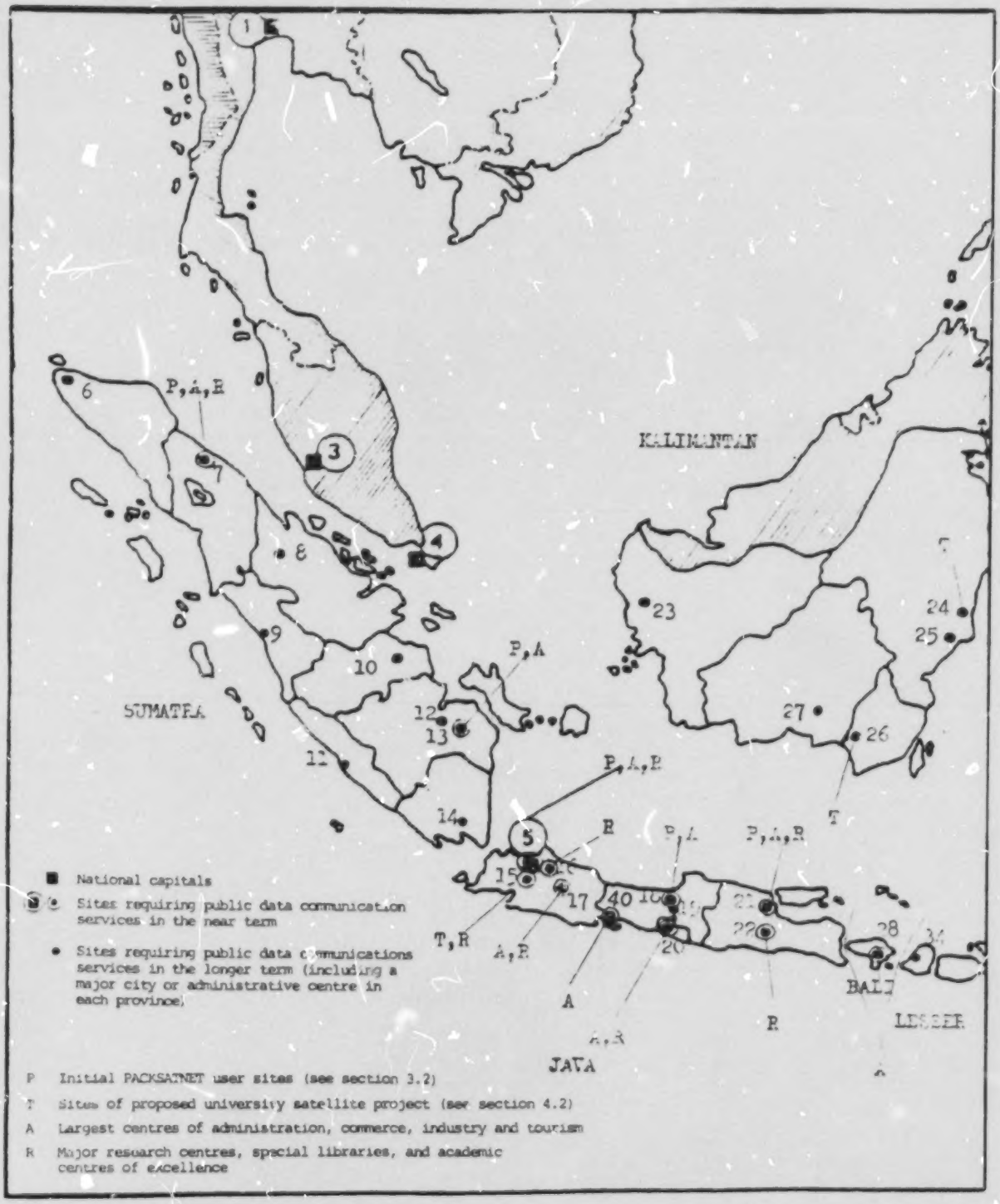
The Indonesian language, called Bahasa Indonesia and written in Roman characters, is employed throughout the country; in particular it is the language used in administration, education and the press. In addition the different ethnic groups in Indonesia speak about 250 languages and dialects, the majority of which are not mutually comprehensible. By 1980, the literacy rate of the population had attained 64%, and nearly all of this group can thus be reached by written information in the national language. Bahasa Indonesia is closely related to the national language of Malaysia but is not understandable in the other countries of the region. The principal foreign language used today in Indonesia is English; it is widely employed in the sectors of higher education, science and technology, public administration and commerce. Other foreign languages, such as Dutch, French, German and Japanese are understood by much smaller segments of the population.

The highest authority of Indonesia is the People's Congress. It elects the President of the Republic who in turn forms and directs the Government, presently comprising thirty ministers and secretaries of state. For administrative purposes the country is divided into 27 provinces which in turn contain 291 regencies (districts) and municipalities. The provincial governors, and to a lesser extent the heads of regencies, have considerable administrative powers, and local representative assemblies form part of the governmental structure at both these subnational levels. The vast majority of the population lives in 60,000 traditional rural villages, which, although not formally incorporated within the country's administrative structure, form the basic social unit in the Government's efforts to improve the welfare of the rural population (1).

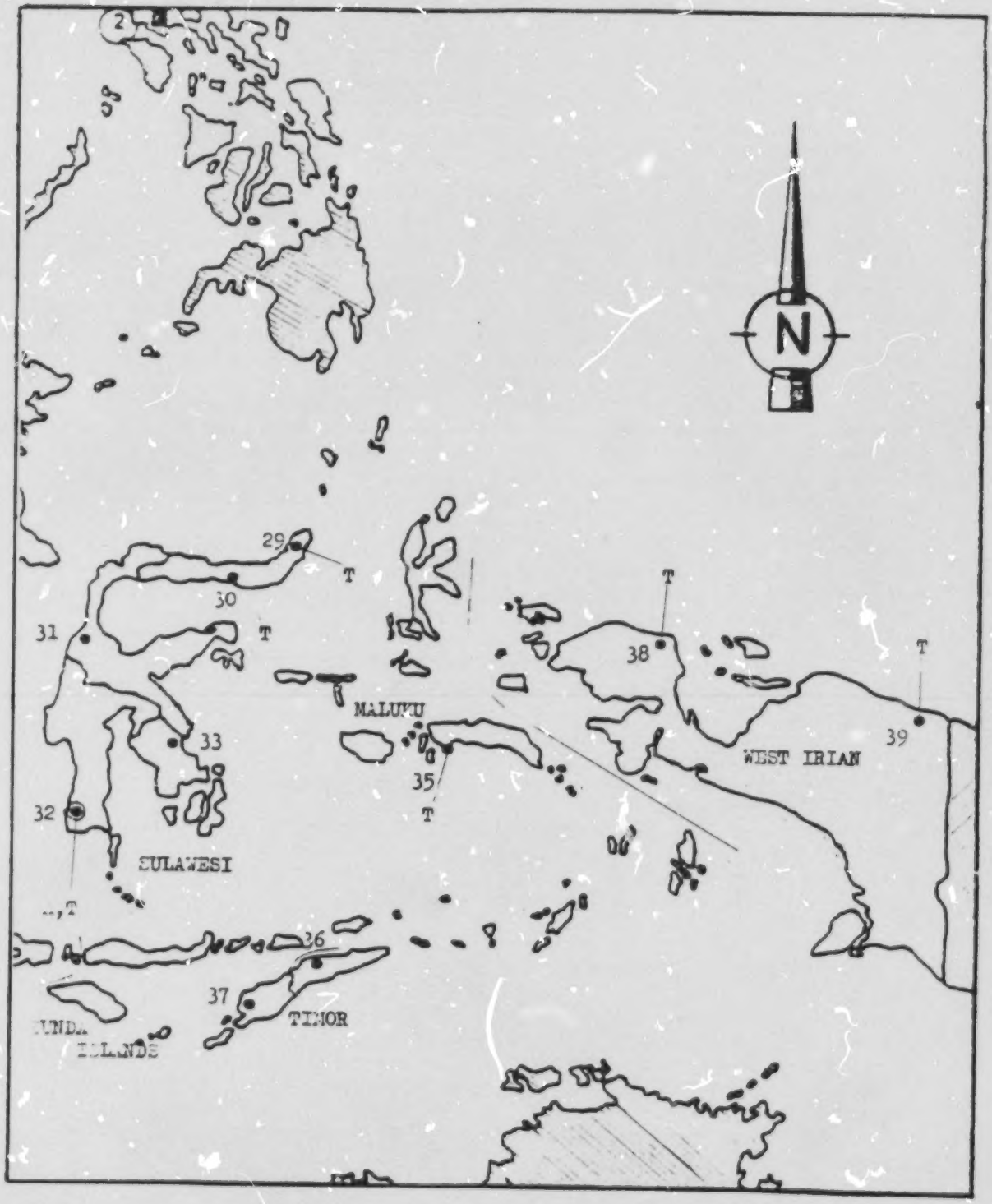
The development policy of the country is embodied in the five-year development plan, elaborated under the responsibility of the National Development Planning Agency (BAPPENAS). The present plan, which is called Repelita III and began in April 1979, fixes the following essential goals: to raise the living standards and knowledge of the Indonesian people, to strive for a more equal and just distribution of welfare for the whole population, and to lay a strong foundation for the next stage for the development.

During Repelita III, priority is being gradually shifted from agriculture to industry, which is accorded the highest sectoral growth rate of 11.0% compared with a planned total annual economic growth of 6.5%. It is expected that Repelita IV will complete the process of basic industrialization by building on experience in fabricating intermediate products in order to manufacture finished products and industrial machinery. In view of their importance in interconnecting the various

FIGURE 1: MAP OF INDONESIA SHOWING SITES OF NEED FOR DATA COMMUNICATIONS SERVICES


KALIMANTAN
SUMATRA
JAVA
BALI
P,A,R
P,A
R
T
T,R
A,R
A
■ National capitals
● Sites requiring public data communication services in the near term
• Sites requiring public data communications services in the longer term (including a major city or administrative centre in each province)
P Initial PACKSATNET user sites (see section 3.2)
T Sites of proposed university satellite project (see section 4.2)
A Largest centres of administration, commerce, industry and tourism
R Major research centres, special libraries, and academic centres of excellence

1. BANGKOK
2. MANILA
3. KUALA LUMPUR
4. SINGAPORE
5. JAKARTA
6. BANDA ACEH
7. MEDAN
8. PAKANBARU
9. PADANG
10. JAMBI
11. BENGKULU
12. PALEMBANG
13. PLAJU (refinery)
14. TANJUNG KARANG
15. BOGOR
16. SERPUNG
17. BANDUNG
18. SEMARANG
19. SURAKARTA



20. YOGYAKARTA
21. SURABAYA
22. MALANG
23. PONTIANAK
24. SAMARINDA
25. BALIKPAPAN
26. BANJARMASIN
27. PALANGKA RAYA
28. DENPASAR
29. MANADO
30. GORONTALO
31. PALU
32. UJUNG PANDANG
33. KENDARI
34. MATARAM
35. AMBON
36. DILI
37. KUPANG
38. MANOKWARI
39. JAYAPURA
40. CILACAP (refinery)

regions of the country, and particularly the rural areas, transportation and communication have been accorded the second highest growth rate of 10.0%. The above figures include development contributions from both the public and private sectors; the central government is expected to provide 51% of the total national investment and to create a favourable climate for investment of the remaining funds by the private sector (2).

The development plan is indicative in nature, and the detailed execution of its projects and programmes is spelled out in the Government Annual Budget. The draft state budget for the '982-83 fiscal year foresees 'development expenditures' of 8.6 trillion Rupiah* of which the three major sectors for public investment are education, agriculture and communications/transportation/tourism. Within the last sector high priority is being accorded to the development of infrastructure for land, sea and air transportation and, subsequently, lower priority is being given to telecommunications. As a matter of policy the Indonesian Government is working towards the goal of auto-financing national development. Domestic receipts will account for 78.5% of the development budget in fiscal 1982-83 and foreign funding for only 21.5%. To finance regional development programmes, central government grants are increasingly being provided to the provinces which are also urged to increase their revenues to enable them to expand their own development activities (3).

The Ministry of Information is responsible for developing the overall information and communications policy of Indonesia, which is essentially concerned with ensuring balanced information flows within the country and between Indonesia and foreign nations. The major information and communications goals of the country are: 1) improved information flow to the rural areas; 2) 'two-way' communications activity by which information users can provide active feedback concerning the orientation of development activities; 3) a 'cultural approach' by which the cultural identity and diversity of the population is respected and 4) an integrated policy for information transfer in the various sectors using information in national development (4).

In the practical implementation of the above policy, development activities concerning the different channels and sectors of information may be carried out independently or coordinated through the consultation and cooperation of one or more concerned ministries: the Ministry of Information is responsible for public information and the mass media; the Directorate General of Posts and Telecommunications within the Ministry of Communications for development of the telecommunications network; the Ministry of Education and Culture for overall library development and the university library system; and other ministries, notably the Ministry of State for Research and Technology, for sectoral scientific and technological information activities.

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* As opposed to 'routine expenditures' of around Rp 7 trillion (7,000,000,000,000). One United States dollar equalled approximately Rp 634 in early 1982.

II. Review of data communication technology

2.1 Computer networks, data networks and ISDN

Computers now provide an extremely rapid and efficient means for handling information through automation of data collection, classification and indexing, updatings, preparation of statistics and reports, visual representation of data, as well as retrieval of the particular information required by the user. Through the marriage of computer science and telecommunications technology, referred to as 'tele-informatics', data can be processed or requested by a user who is far away from the computer he is employing. If the computer lacks certain required information, it can be obtained from another through a connection set up between the two computers. In providing for remote computer access by many dispersed users and for computer resource sharing, computer networks - systems of computers and user terminals which are interconnected via telecommunications - can be designed to improve facilities for information transfer by ensuring:

- interworking of types of equipment which would otherwise be incompatible

- high reliability in data communications

- security of information.

A 'data network' is the telecommunications system that carries data flow within a computer network, i.e., between terminals, between a terminal and a computer, or between computers. In the 1960's the first computer networks used a 'star' pattern for data transmission with a single central computer (host) controlling network operations through leased telecommunications lines. In the beginning of the 1970's, more complex networks developed but data communications were still controlled by a front-end processor associated with the hosts of the network. A new step was reached in 1975 with the development of data networks in which all communications are managed by a specialized computer (network management centre) which is an integral part of the network itself rather than depending on the hosts; these data networks were in general privately managed but could sometimes be accessed by outside users through the public switched telephone and telex networks.

Starting in the 1980's, national public data networks have been implemented and interconnected through 'inter-network transit nodes' (international gateways) (5). This approach provides common data transmission facilities for both private and publicly accessible computer networks, as well as for terminal-to-terminal data transmission. Public data networks have reduced the importance of private data circuits which often have a low utilization rate and thus a relatively high cost.

As a long-term programme, public digital networks which carry both voice and non-voice services (integrated services digital networks - ISDNs) are being planned by a number of countries. In an ISDN, voice, data, text and drawings will be transmitted by in digital form at a standard of speed 64 kbits/s for all the services. However, using presently available technology the cost and complexity of this approach, which requires a conversion of the entire public switched telephone system to digital equipment, is very high; specialized public data networks will thus undoubtedly continue to be seen in the foreseeable future as a viable option for handling data communications in most countries.

All data networks must be designed to transmit data in a form which can be 'understood' by the terminals and hosts being served, which means that standard procedures, called protocols, are used to set up, execute and check the result of each data 'call'. The switching of data between users can be performed by two different techniques: circuit switching which is used in a circuit switched data network (CSDN) and packet switching which leads to a packet switched data network (PSDN). All of the recommendations of CCITT (the International Telegraph and Telephone Consultative Committee of ITU) on CSDN and PSDN techniques are described in the CCITT 'Yellow Book', volume VIII, and all of them belong to the X series. In the circuit switching technique, which historically was the first one implemented, an end-to-end data circuit having a definite bit rate is reserved for the entire duration of a call, and this technique is well adapted for heavy traffic between large users.

2.2 Packet switched data networks

Since the Indonesian telecommunications administration has chosen the packet switching technique for its pilot data network, it seems appropriate to briefly describe some important technical characteristics of a PSDN. Packet switching does not provide a fixed allocation of a data circuit between two users for the duration of a call; it reserves circuits only for the transmission of message elements called data packets. A circuit can thus be shared among several users who make use of the available transmission capacity virtually simultaneously. This method of optimizing transmission is particularly suitable for short messages.

The packets are headed by service data for routing purposes (addresses, packet numbering, etc.). The commands for packet routing are set up by specialized computers in the nodes of the network in the form of temporary or 'virtual' circuits which are sequentially opened during the call. For this reason, these nodes are often called 'packet switching' exchanges' (PSE) or virtual circuit nodes (VCN). A special node, called the 'network management centre' (NMC), supervises the traffic, the quality of the transmission links and the operation of the PSE's in such a way that the error rate of the transmitted packets is very low (less than one in each 100,000,000 packets).

In the framework of this report it is not possible to explain all the details of a PSDN or the level of resources required for such a network, and the reader is referred to general texts (5). A brief discussion will however be given on satellite communication, and particularly the use of satellites for data transmission between PSE links.

2.3 Satellite communication

In order to achieve wider sharing of information resources, there is an increasing need for cost-effective, long-haul, wide-band (high capacity) communication facilities, and communications satellites show great potential in this respect. However, consideration of some particular technical points such as the distribution of transmission capacity among users may lead to the choice of a particular satellite technique over another, or to a decision to develop a data network using both satellite and terrestial links.

A communications satellite normally has far greater capacity than required in any single link of a data network. The division of the resources of a satellite into a number of inter-node data links can be performed by using the following multiplexing techniques (5, 6):

- spatial multiplexing;
- frequency division multiple access (FDMA)
- time division multiple access (TDMA) including :
  . synchronous TDMA
  . asynchronous TDMA
  . packet broadcasting techniques

In spatial multiplexing, separate transmission facilities in the form of an entire satellite transponder are allocated to each function of the network. Each transponder contains an input filter to limit reception to a selected region of the uplink (earth to satellite) frequency band followed by a frequency translator, power amplifier and output filter to limit transmission to a specified region of the downlink (satellite to earth) frequency band. Thus, the overall satellite power and bandwidth is divided up on a frequency basis. Typical transponders can handle maximum overall data rates of 60-120 Mbits per second for communications to large earth terminals (e.g. 32 m antennas) and perhaps 10-20 Mbits/s with small earth terminals (e.g. 5 m antennas) through the use of coding techniques.

In FDMA, division of satellite capacity into channels is achieved by assigning a segment of the total bandwidth of a transponder among the various access subgroups (e.g., the data transmission links) and confining the transmission of each subgroup to an allocated sub-band. Non-linearities in the transponder power amplifier normally lead to intermodulation noise which reduces the effectiveness of this technique. In the case of TDMA, 'channelization' is achieved by assigning periodic time slots, each of which uses the entire transponder bandwidth and power, among the various access sub-groups. Fixed time slot allocation is called synchronous time division multiple access (STDMA); if the time slot allocation is dynamically modified according to demand, it is called asynchronous TDMA (ATDMA). TDMA allows more flexibility than FDMA in establishing and adjusting the data rates individual links to the average traffic demands.

Depending on their characteristics, communications satellites are in general capable of supporting transmission within a CSDN, a PSDN or both. Packet broadcasting is, however, a special case of the TDMA technique which applies only to PSDN's. In contrast to the previous methods for setting up a number of individual point-to-point data links, it consists in systematically broadcasting all transmitted packets to each network customer. In this approach, each receiver must determine if a particular packet is meant for him or for another user. The principal advantage of packet broadcasting is that each user can transmit data without waiting for an end-to-end circuit to be set up, while the principal disadvantage is that packets from more than one user can be received simultaneously by the satellite and some can thus be lost. A number of different approaches in recent years have attempted to establish the proper balance between these two factors, the best known of which follow:

The simplist form of packet data broadcasting is called pure or unslotted ALOHA and involves no time synchronization of transmissions. In this 'random access' method, each sending station monitors the success or failure of its transmissions on the basis of acknowledgements from the receiver and queues unsuccessful packets for retransmission after the maximum two-way transmission time has elapsed. Using unslotted ALOHA, the greatest channel efficiency achievable for a population of about twenty or more stations, each with the same traffic rate, is about one sixth of the available satellite capacity. One should note that the Indonesian PACKSATNET experimental data network is using this technique (7).

The slotted or synchronized ALOHA technique, in which each station begins its transmissions at the beginning of a fixed time slot, can double the efficiency of the system.

Reservation-ALOHA is a third category of packet demand assignment in which the use of a data transmission frame permits implicit reservations within the slotted ALOHA approach. The duration of the frame is at least equal to the two-way earth-to-satellite propagation time. Each earth station keeps a record of the time slot utilization during the previous frame. When a packet needs to be sent, transmission is attempted in one of the free time slots of the previous frame. If the attempt is successful (that is to say if the packet is received by the satellite), this time slot is allocated to the emitting earth station as long as required in the succeeding frames. Within the reservation-ALOHA scheme, priority-oriented demand assignment (PODA-ALOHA) is a technique particularly convenient for packet satellite networks in which transponder time is divided into two basic subframes: an information subframe using STDMA for data stream transmission, reservations and acknowledgements and a control subframe using ATDMA.

2.4 The SATNET experiment

The use of state-of-the art satellites for accessing public data networks from other public telecommunications services raises a number of unresolved issues. Among these are the ways in which the special message requirements of satellite data networks (e.g., assignment of priority and holding time of packets, error control and packet sequencing) and those of certain user applications (interactive terminals, facsimile, etc.), can

be accomodated efficiently within the combined system. In order to study techniques that might resolve those problems, an experimental programme called SATNET was set up in 1975 by a number of sponsors. The participating organizations are Bolt Beranek and Newman Inc. (BBN), the Communication Satellite Corporation (COMSAT), the Linkabit Corporation, the Massachusetts Institute of Technology (MIT) and the University of California at Los Angeles (UCLA),all in the United States of America, the University College of London in England and the Norwegian Defense Research Establishment (8). Some initial results of the SATNET experiment have been obtained and were published in 1978-79 after simulations and tests using an Intelsat channel for access to the ARPANET data network. SATNET is currently serving as the backbone for a number of innovative research applications (e.g., choice of data network architecture parameters and of protocol assignments as a function of network criteria such as number of earth stations, the operational environment, types of traffic, questions of quality, acceptable noise levels, etc.). A major goal is to explore the use of the SATNET technology to support multi-user integrated voice and data communication by packet techniques.

The conclusions of the SATNET, as presented by the researchers involved, can be summarized as follows: (9, 10, 11, 12)

- The basic idea of an improved ALOHA technique employing burst-by-burst monitoring is expected to play a central role in future integrated telecommunications systems;

- The experiments have demonstrated the capabilities of a broadcast network that can handle both data and voice traffic;

- New satellite channel interface hardware will have to provide a number of specific diagnostic features to aid in the detection of hardware malfunctions;

- The first results show that the exploitation phase of SATNET is still in its infancy and is not yet optimized. More results are expected in mid-1982.

It should be stressed, however, that the community of tele-communications engineers has not yet had access to communications which present in detail the positive results of the SATNET experiment.

2.5 Tele-informatics services

In response to increasing user demand for specialized communications facilities, telecommunications administrations are sponsoring a growing number of standard tele-informatics services which make use of public telecommunications networks. Most of these services involve data communications. Their development thus often goes hand-in-hand with the establishment of public data transmission facilities.

A brief overview of the existing tele-informatics services is given hereafter, while the reader is referred to other sources (13) for further details.

- Telex will remain an essential service for business and official relations. The Telex network will not disappear fast in spite of the emergence of the data networks because too many customers use this network throughout the world, but telex traffic is a type of data communication and may well be integrated with data traffic for reasons of efficiency.

- Facsimile, which permits the rapid transmission of documents such as diagrams, financial tables and typed or hand-written texts with faithful reproduction of authentification signs, may interest many sectors of professional and economic activity. High speed digital facsimile terminals are particularly suitable for use on public data networks.

- Teletex is a newly developing service which combines local text processing capability and rapid text transmission. It is convenient for large enterprises, particularly those with decentralized offices. The planned interconnection of teletex with telex should enable teletex to develop gradually to a high rate of utilization.

- Videotex (or viewdata) is an interactive video terminal service having numerous areas of application: information retrieval from data banks, commercial transactions, selection and remote execution of computer programs, message services, etc. Due to its very low cost, the videotex terminal (which can be self-contained or consist of an attachment to an ordinary TV set) will interest residential users as well as institutions and users of scientific and technical information. The information displayed by the videotex terminal is transmitted in the form of standard graphic elements, and specific options allow the user to receive information on the screen in one or more of the following forms:

- alphanumeric characters and pictures formed by assembling predefined building blocks (mosaic technique)

- alphanumeric characters and pictures formed by specifying lines (geometric technique)

- alphanumeric characters and photographic images

C.E.P.T (The European Conference of Post and Telecommunications Administrations) has agreed on a videotex standard, and interfaces now allow the interconnection of European videotex systems as well as information exchange between non-videotex computer systems and videotex terminals.

- Broadcast videotex (or teletext) involves the continuous transmission of data by a TV network (rather than by telecommunications links), and its selection by the user through an alphanumeric keyboard attached to his TV set. The pages of data are transmitted using either the unused blanking intervals in normal TV programme broadcasting or separate full TV channels. This technique could be quite useful in developing countries which already have TV sets in service to broadcast administrative or other public information in remote areas. It is possible to use the same receiver for both interactive and broadcast videotex in order to allow multiple usage and reduce terminal costs.

Remote video projectors of about 3 m2 could be used as receivers. They are less expensive (about US$ 5000) than classical projectors (eidophores) and can be adapted for use as a broadcast videotex device as well as projecting ordinary TV programmes. They have proven very successful in small communities (about 50 people) for seminars or in school programmes.

- Electronic mail (or message service) involves the storing of messages and forwarding them to the addresses (including multiple addresses) when it is appropriate. Confidentially is ensured by the use of passwords.

- Telecharging is a special service allowing users to buy products from their premises. The products may be shown on a video display unit (VDU) as part of a videotex service. This type of system permits a check of the user's credit card and the transfer of money from the buyer to the seller the day the order has been placed.

- Telewriting sets allow people attending an audio- or a tele-conference to transmit immediately to one another drawings made on a special pad.

- Tele-alarm is a service for transfer of an alarm signal, e.g., from a bank to the police or from an elderly person to a hospital.

The technical characteristics of a number of standard tele-informatics services are reviewed in figure 2.

III. The Indonesian telecommunications network

3.1 Development of national telecommunication services

The national telecommunications system in Indonesia is placed under the responsibility of the Directorate General of Posts and Telecommunications within the Ministry of Communications. Three operational government-owned enterprises have in turn been set up under the Directorate General:

- PERUMTEL, the national telecommunications administration, which is responsible for development of the national network,
- INDOSAT which provides international telecommunications facilities, and
- P.T.INTI, the manufacturing arm of the system.

Although still modest in size, the Indonesian telecommunications network is developing steadily. An extensive terrestrial microwave transmission system crosses the islands of Sumatra, Java and Bali and provides links to major cities in Sulawasi and Kalimantan. A Domestic Satellite Communication System, initiated in 1978 to provide telecommunications support for the Government's development programmes, already ensures telephone trunk lines and TV transmission to many outlying areas. Most of the major urban centres are thus connected together by the trunk links which are shown in Annexes 2 and 3.

FIGURE 2 : EXAMPLES OF DATA TRANSMISSION AND TELE-INFORMATICS SERVICES

Service	Type	CCITT reference	Telecommunication means	Applications	Clients
TELEX	24 channels 50 bauds	R 35	Analogue circuits	Short message in the Roman alphabet	Administrations Business Press
	46 channels 50 bauds 120 channels 50 bauds	R 101 (2400 bps) R 111 (64 kbps)	Analogue or digital circuits		
FACSIMILE	Analogue Group 2	T 3	Public telephone network	In less than 3 mn	Administrations Business Information centres
	Digital Group 3	T 4	Radio links and cables	In less than 1 mn	
	Group 4	Under study	Data networks	Under study	
				Transmission of copy in A4 format with Roman (or other) characters & diagrams	
TELETEX	Analogue Digital 2400 bps, 82 characters per line	F. 200 S. 60	All data networks All digital or analogue networks (with modems)	Preparation of the message off line with texts and data stored in text banks. Transmission of A4 format in less than 10 sec.	Administrations Business
VIDEOTEX	Broadcast videotex (teletext)	None	TV transmission links	General information services	TV watchers
	Interactive videotex . Block mosaique procedure . Geometric procedure . Photographic procedure . DRCS procedure 40 characters per line	S. 100 F. 300 CEPT standard	Telephone or data networks (asynchronous 75/1200 modem)	Interactive information on a screen page with possibility to transfer it onto paper medium Message services	Administrative and legal information Commercial transactions Marketing services Public information retrieval service Entertainment Education Electronic directory
ELECTRONIC MAIL	Accorded to users of the existing channels in the national network	Under study	Voice mail on leased lines on ISDN connections Written message mail on telex on teletex on videotex on elect. mail link	Message switching and message dissemination	Administrations (for executive staff) Business
TELECHARGING	Part of the interactive videotex service	Under study	Telephone or data networks with videotex terminal and with magnetic card and card reader	Payment in the customer premises	All users of services Business Trades Transportation agencies
TELECONFERENCE	Audioconference	Under study	2 or 4 wire circuits	Conference between remote participants having a fully equipped room at their disposal in each location	Administrations Large enterprises Educators
	Videoconference	Under study	TV channels or ISDN support		
TELEWRITING		Under study	Analogue circuits using a modem or digital channels	Simultaneous reproduction on a TV screen of any information elements drawn on special equipment	Administrations Large enterprises
TELE-ALARM		Not a CCITT concern	Outband channel in the local network	Bank alarm (police alarm) Water flow level alarm Telemeasurement Alarm for the elderly or chronically ill	Private users Banks Meteorology office Airports Civil Protection Agency

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At the end of '981, more than 500,000 customers were connected to the telephone network, representing more than one telephone per three hundred inhabitants. The telex network had nearly 5000 customers at the end of '980. Annexes 4 and 5 give figures related to the progressive growth of these networks, as well as the revenues and investments for the '970's. The research in telecommunications field. The Indonesian TV network already serves about three million clients.

In order to mitigate the most critical needs in telecommunication, some large companies and public offices have developed their own extensive private telecommunication networks, involving both independent radio networks and leased lines, with the agreement of Indonesian authorities. This problem, which has led at times to a sort of overabundance or duplication of means of transmission, is considered as provisional, and it is foreseen that the private networks will be gradually absorbed as the extension of the public network allows link availability to be improved.

A number of training programmes for telecommunications engineers and technicians are operational in Indonesia, and several institutions including the Training and Development Centre of PERUMTEL are conducting research in telecommunications field. The Indonesian telecommunications network is already using some of the most recent techniques - analogue switching with stored program control (137 automatic exchanges carry 85% of the telephonic traffic), digital transmission, radio links, high capacity submarine cables for international traffic, etc. - and PERUMTEL plans to introduce digital switching. Two satellites called PALAPA with twelve operational transponders are already in use and capacity will be doubled in '983-1984 with the new PALAPA B satellites (see Annex 6). A number of telecommunications components are manufactured locally in Indonesia: for example P.T.INTI is involved in large scale production of a range of radio and switching equipment, as well as telephone sets, in cooperation with a number of foreign investors, and the National Electronics and Electrical Research Institute of the Indonesian Institute of Sciences (LEN-LIPI) fabricates several types of equipment on a custom basis, including the only modems* produced in Indonesia. Both P.T.INTI and LEN-LIPI manufacture satellite earth stations for domestic use, and the National Aeronautics and Space Institute) (LAPAN) has developed a solar generator to power earth stations located in remote areas.

The investment programme for the national telecommunications network is approved through normal government channels and financed exclusively by government subsidies in the form of equity contributions, loans through government institutions and operating revenues. PERUMTEL is increasingly expected to operate on a commercial basis, and direct subsidies are being gradually diminished as a matter of policy. In contrast to P.T. INTI, PERUMTEL is not at present permitted to solicit external loans or investment.

Basic telecommunication services in Indonesia still have to be greatly extended, especially in the Eastern regions (see Annex 2) but also generally speaking in every part of the national territory in order to satisfy the potential demand. It should be noted, however, that coverage of the Eastern part of the country will be substantially improved

* See glossary, Annex 8

with the installation of a microwave network extending down to Darwin (Australia) during the present development plan, and it is expected that domestic submarine cables will be laid in the coming years to facilitate communication with the Eastern islands (see Annex 7). While official projections in 1978 indicated that a level of only about 0.5 telephones per hundred inhabitants would be reached by the end of the century (14), it is now hoped to have about 2.5 million telephones (more than 1.0 per hundred inhabitants) by that time. The present development plan (Repelita III, 1979-84) is seen as a consolidation stage in telecommunications investments after very heavy investments in the previous five-year plan.

The ultimate goal of PERUMTEL is an integrated services digital network suitable for offering diversified telecommunications services, including data communications, to the public. In the meantime, an effort to diversify telecommunication services is underway, and the following new services are presently under study or being tested:

- experimental packet data network (PACKSATNET project),
- electronic mail (within the PACKSATNET project),
- fast telex network (an improvement of the existing telex network to allow circuit-switched data transmission),
- slow-scan video conferencing (see section 4.2),
- analogue facsimile transmission (already in limited use on leased lines and soon to be allowed on the public telephone network),
- computerized telephone directory (for use by telephone operators).

In order to satisfy the immediate demand for data communications facilities, applications are being developed at users' initiatives on leased lines. The use of terminal equipment on the public switched telephone network is not yet allowed, and present regulations would not permit the establishment of a publicly accesible value-added data network using leased circuits. PERUMTEL does not provide modems with leased lines and does not advise on terminal equipment for data communications.

3.2 PACKSATNET

The Government of Indonesia and the United Nations Development Programme have agreed to jointly finance the construction, installation and the operation of a demonstration packet satellite data network initially to be named PACKSATNET (7, 15). The International Telecommunication Union and PERUMTEL are executing the project, which started in 1978.

PACKSATNET will comprise two types of sub-network (see figure 3). The satellite subnet (SATNET) is composed of small earth stations (ES) restricted to data communication. These stations communicate with each other over a shared channel derived from the Indonesian domestic satellite PALAPA. The satellite channel access method used by the ES is the 'unslotted' ALOHA technique (see section 2.3). To control the satellite channel access and the user's network access each ES will be equipped with a micro-processor controlled satellite programmable control unit (SPCU). Communications between user's equipment (DTE's) in the same local area will make use of a ground packet radio subnet (PRNET) employing a further development of the basic ALOHA system. In order to interface with the various DTE's (using the X 25 and X 28 protocols*) and to control access to the common ground radio channel, each remote radio station will be equipped with a micro-processor

* See glossary, Annex 8

based programmable control unit (PCU), and the central radio station with a programmable central control unit (PCCU). The PCCU will also connect the local area subnet with a long-haul satellite subnet. The PCU's, SPCU's and PCCU's of PACKSATNET can each be equipped with an X 28 Access Module which is capable of providing four X 28 ports through which connections to the PSTN could be established; eight telephone dial-up ports (not included in figure 3) will be available in the initial stage.

In addition, the network will have the following facilities:

- The Electronic Message Box (EMB) will enable the user to access incoming messages at his convenience, to dispose them electronically, and to pass them along or file them as he sees fit. It leaves an audit trail, and eliminates or at least reduces the need for paper files.
- The Operating and Maintenance Centre (OMC) consists of a computer connected as a DTE to PACKSATNET with the necessary peripherals. Its main functions are traffic generation and on-line monitoring of network operations.
- For each call, information will be collected by the Charging Information Collector (CIC). This equipment will register all this information which will be forwarded after a certain period of time to the billing centre.

The contract to design, develop, manufacture, deliver and install the PAKSATNET system was awarded in 1981 to PT Industri Telekomunikasi Indonesia (PT INTI) PERSERO which is supported by the subcontractors LOGICA Ltd. and JRS (Japan Radio Company). PACKSATNET is expected to be operational by the end of 1983.

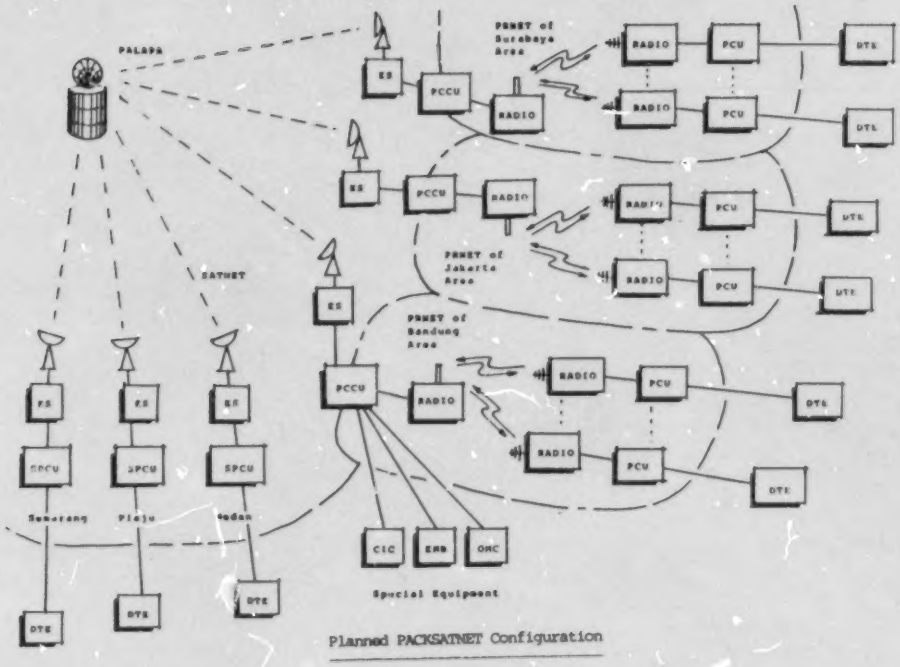
The PACKSATNET experiment presently involves only five user agencies - a large government-owned bank (BRI), the Central Bureau of Statistics, the Ministry of Finance, the national petroleum company (PERTAMINA) and PERUMTEL itself - and services will be limited to three cities in Java and two in Sumatra. The network will be employed mainly for internal data transfer between decentralized offices of the participating agencies. Several other organizations have shown an interest in PACKSATNET, and the national authorities have already envisioned several possible strategies for expansion of the system after success of the initial demonstration. However, because of the experimental nature of the project, detailed technical studies have not yet been undertaken on possibilities for expansion of the network or for future public access.

There are some particular aspects which require further consideration before PACKSATNET can be expanded in view to a large commercial opening:

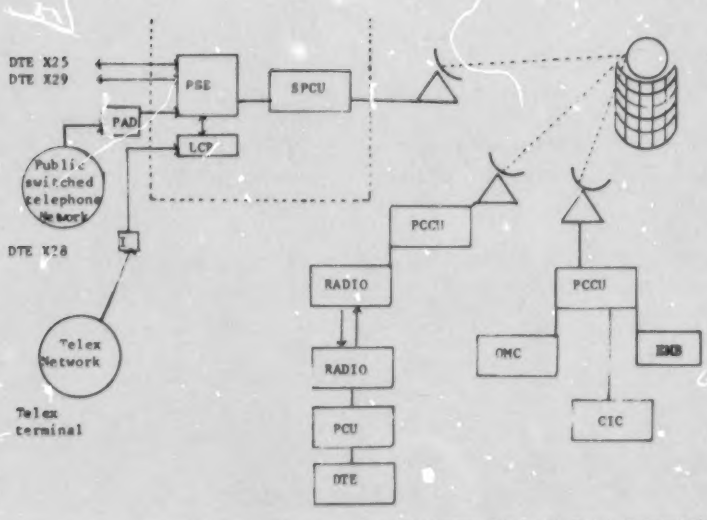
- the design of the project to interconnect a large number of national customers,
- the use of the newest available techniques to enhance the maximum throughput of the common chanels,
- a plan for connection to foreign networks.

It should be noted that 70% of the funding for the network is being provided by the Indonesian Government, and that national industries and consulting organizations specializing in advanced telecommunication technology have had major responsibilities in design and implementation of

FIGURE 3 : PLANNED PACKSATNET CONFIGURATION AND SUGGESTED EXPANSION THROUGH PSTN CONNECTIONS



Planned PACKSATNET Configuration



Suggested expansion of PACKSATNET through PSTN connections for sites in which a large number of customers is expected (link at upper left of diagram)

PCCU : Programmable Central Control Unit
SPCU : Satellite Programmable Control Unit
PCU : Programmable Control Unit

ES : Earth Station
OMC : Maintenance Control Centre
CIC : Billing and Statistics Unit
EMB : Electronic Mail Box

PSE : Packet Switching Exchange
LCP : Local Control Point
DTE : Data Terminating Equipment

the project. Thus, from the Indonesian point of view, PACKSATNET is seen as an opportunity to gain experience and skills in packet data networking and transmission of data by satellite, while providing useful initial services to a limited number of priority data users.

3.3 International facilities and regional cooperation

The Indonesian telecommunications network is interconnected with other national networks both by satellite and submarine cables. International telephone and telex services are provided, as well as leased lines for both traditional uses and data communication. Teleconferencing and graphics transmission will soon be available between Jakarta and Singapore. Jakarta is presently the only Indonesian international gateway, but another will be established at Medan in 1983.

Indonesia and the four other ASEAN countries are all members of Intelsat and make use of Intelsat facilities in establishing international telecommunications links; the five countries cooperate to ensure a common policy on Intelsat matters. An extensive submarine cable network is being developed in the ASEAN region and is coordinated by a joint Management Group within the ASEAN Committee on Transport and Communication. Five international cables (Philippines-Singapore, Indonesia-Singapore, Singapore-Malaysia, Malaysia-Thailand and Indonesia-Malaysia), have already been laid in the period 1978-80, and a connection from the Philippines to Thailand, as well as an extension of the system to the Middle East from Malaysia are planned. These facilities and other existing or proposed international submarine cables in Asia are shown in Annex 7.

As the only ASEAN country with a domestic telecommunications satellite system, Indonesia is leasing these facilities to neighbouring countries for domestic television transmission and some rural telecommunication applications at the national level (see Annex 6). Intelsat regulations prevent the use of PALAPA for regular international telecommunications in the region.

At the Asia and Pacific level a Regional Planning Committee for telecommunications meets every four years under ITU auspices. Cooperation among the Asian telecommunications administrations is being developed on a regular basis through work of the Asia Pacific Telecommunity. The Telecommunity has recently completed a comparative study on national and international telecommunications tariffs which is being considered within the national administrations in view to harmonizing tariff policies in the region (16), while a comprehensive survey of telecommunications traffic in Asia, including an analysis of several factors bearing on tariff policy and possibilities for resource sharing, has been undertaken under ITU auspices (17). Although both of these studies concentrate on telephone and telex as the major telecommunications services in the region, many of the conclusions and analytical techniques should be useful in developing cooperative approaches in the area of data links. In the area of telecommunications training, a project for international exchange of information in South-East Asia is being developed within the CODEVTEL programme of ITU.

IV. Information resources and needs

4.1 Specialized information services

In the present report the term 'specialized information' will be used to cover the scientific and technological information and the socio-economic information which is required by specialists in carrying out their work. It is generated through activities such as research, experimental development, social surveys, operational projects and public administration, and is of interest to specific categories of researchers, technical development personnel, planners, decision makers or other practising professionals. Specialized information should be distinguished from 'organizational information' which is generated for use in administration or decision making within a single organization, from 'general information' such as news which is of interest to large segments of the general population, and from 'personal information' consisting of messages between individuals. The transmission of these four types of information can be facilitated to various degrees by data communication techniques, and they should therefore all be considered in formulating a national approach to data communications.

Specialized information services are provided by information centres which collect, process and disseminate information. These centres are basically of two types:

- special libraries and documentation centres which handle documents

- data centres handling factual data which is usually numerical or statistical in character.

A very complete survey of specialized information sources in Indonesia, emphasizing libraries and documentation centres, is included in a recent survey prepared in cooperation with Unesco (18). These resources, including 213 special libraries and major university libraries in 1978, are located mainly in Java, and are organized within several specialized information networks :

- the Documentation and Information Network for Science and Technology is coordinated by the National Scientific Documentation Centre (PDIN), in Jakarta, of the Indonesian Institute of Sciences (LIPI);

- the Documentation and Information Network for Biology and Agriculture is coordinated by the Central Library for Biology and Agriculture in Bogor;

- the Documentation and Information Network for Health and Medicine is coordinated by the Ministry of Health in Jakarta;

- the Documentation and Information Network for Social Sciences is presently coordinated by PDIN;

- the university library network, in the process of being formally established, relies heavily on the libraries of the nine academic centres of excellence which sponsor post-graduate programmes, all in Java, and a number of principal universities designated in the other regions;

- other sectoral networks are usually coordinated by the ministry responsible for a given sector; among the most highly developed are those covering energy, environment, family planning and law.

In addition to its operational role in providing information to support research and industry, PDIN is responsible for formulating national policy in the area of scientific and technological information.

The National Library of Indonesia was created only in May 1980 within the Ministry of Education and Culture through an amalgamation of four existing libraries. It is responsible for maintaining the national bibliography, and its role is expected to be strengthened by a new legal deposit law under consideration. It also maintains a strong specialization in the social sciences.

The libraries and documentation centres in Indonesia are making substantial efforts to identify and collect all of the documentation produced in the country, including the 'grey' or unpublished literature, and to acquire needed publications from abroad. Users, however, still face significant difficulties in gaining access to specialized information, due primarily to insufficient holdings, manpower shortages and problems in resource sharing which in turn are linked to inadequate communication of information. The especially difficult situation of the university libraries, resulting from the rapid expansion of higher education in Indonesia since Independence, is summarized in a recent Unesco mission report (19).

4.1.1. National bibliographic databases

Numerous activities designed to coordinate resources and ensure wider dissemination of information have led to useful bibliographic publications, including the Indonesian national bibliography and indexes (prepared by PDIN) of Indonesian learned periodicals, research and survey reports and dissertations. In addition there exist a national union list of serials (prepared by PDIN), union catalogues of holdings in major cities such as Jakarta (compiled by the National Library and PDIN) and Bandung (by the ITB Library),as well as useful referral tools like the national directories of special libraries and of researchers (prepared by PDIN). A least one of these files - the national union list of serials - was generated by a computer in batch mode (using the facilities of the Ministry of Public Works). Major problems cited by users as limiting the effectiveness of the national bibliographic and referral files are their incomplete coverage and insufficient timeliness; in addition they are often little known to the end-users of information and consequently are under-utilized. Union catalogues still do not exist for the holdings of numerous major university libraries.

Although none of the specialized information centres regularly uses a computer for automation of acquisition, cataloguing or information retrieval, computerized bibliographic databases are under development or planned at several institutions. Among these should be mentioned the database of the Electric Power Research Centre on non-conventional energies, a pilot programme to develop computer applications, including computerized library services, with World Bank assistance in three universities (the University of Indonesia in Jakarta, Gadjah Mada

University in Yogyakarta and Andalas University in Padang), and the plans of PDIN to make use of an in-house mini-computer for information work. Other centres, including the National Library and the Library of the Bandung Institute of Technology (ITB), are studying possibilities for computerization, and automated techniques will certainly become widespread in the future as computers become generally available to libraries and documentation centres and as the quantity of the documentation to be treated continually increases.

4.1.2 Library networking

In 1978 about 100 special and university libraries reported having their own telephone and about 50 more had access to a telephone in another part of the parent institution. In contrast, only three libraries had their own telex facilities although several others presumably can make use of the telex installation of their parent institution. Apparently none of the libraries as yet makes regular use of a facsimile terminal in its work. The major reason for the scarcity of telex use, which is considered in developed countries as essential for library networking and access to information, is apparently the high costs involved.

Because of the limited resources available for building library holdings and the rapidly increasing number of information centres and users throughout the country, the smaller libraries will have to rely heavily for the immediate future on the few existing large collections in Indonesia. And even when the basic holdings of the library system improve, it will be necessary to ensure rapid access to monographs and serials deposited in specialized information centres in Indonesia and abroad. PDIN is presently providing copies of about 5-6000 journal articles annually to end-users and other information centres; about 60% of these are obtained from foreign sources, mostly in the United Kingdom and neighbouring Asian countries, and a significant number are obtained from other major libraries in Indonesia. In addition to serving local users on the basis of its own holdings, the ITB library provides nearly 300 documents annually to other national information centres and requests a greater number from other centres, mainly from abroad.

Although telex is already used by several major information centres for urgent international requests for photocopies, searches and acquisitions, its use within Indonesia for inter-library requests is very limited due to the very small number of libraries with access to terminals. The provision of a telex facility for use by each of the special and university libraries in Indonesia is thus seen as a priority need in applying telecommunications to information transfer. In addition to carrying requests for loans or copies of documents, such a system would enable the libraries to initiate on-line retrieval activities from foreign and Indonesian databases in awaiting the availability of specialized terminals and circuits for this purpose. Telecopy facilities would also be very useful in satisfying urgent requests for the transfer of documents between libraries when the distances involved would otherwise cause long postal delays, e.g., when centres outside of Jakarta or abroad are concerned. This problem is particularly acute for the universities situated on the eastern islands, and facilities for transmission of documents have already been included in a planned pilot project for using telecommunications to improve higher education (see Section 4.2.).

4.1.3. National factual databases

Several sophisticated information systems providing numerical and factual data are already operational, under development or planned in Indonesia. In the socio-economic area the Central Bureau of Statistics (BPS) has for many years collected data by survey and provided it to government offices, the general public and foreign users through an extensive series of statistical publications. Decentralized offices at the regency and municipality level enable the Bureau to reply to questions on the local situations in these regions.

The processing of statistics at BPS is steadily being computerized, and a large portion of the national statistical database is already operational. In addition to its two main computers in Jakarta, the Bureau maintains an autonomous computer in Surabaya and two stand-alone terminals in its Bandung and Semarang offices which will soon be connected by leased line to the Jakarta computer facility; there are plans to install additional on-line terminals in Ujung Padang and Medan.

The only external on-line user of the national statistical database at present is BAPPENAS which is connected directly by leased line to the main BPS computer for information retrieval and economic modelling applications. Although it is expected that other government departments will also eventually have direct access to the database, there are apparently no plans to offer computerized products or on-line services to the public. Some datas are provided on magnetic tape to ESCAP in Bangkok which compiles regional statistical publications, but no demand for on-line access by foreign sources is presently foreseen. Considering the favourable experience of the industrialized countries in this area, on-line access to statistical data on the population and on national economic activities should ultimately prove very useful for research and business in Indonesia as well as to foreign users; development of the national database in this direction may well be appropriate in the future.

In the private sector only one company (called In-Search Data) regularly collects socio-economic data through field surveys; the results are processed by computer in batch mode and sold as published reports that are useful in marketing and advertising. This type of activity can be expected to grow gradually in Indonesia in parallel with the growth of advertising and of business, and may well lead to publicly accessible databases in the intermediate term.

In the area of natural resources data the National Coordination Body for Survey and Mapping (BAKOSURTANAL) in Bogor has developed a highly sophisticated database which uses computer graphics to compile and display thematic maps. It is available on-line but only within the parent institution at the present time. Two other factual scientific databases, which have been already developed for restricted usage, cover meteorogical data (within the National Institute of Meteorology and Geophysics) and petroleum resources (compiled by the Ministry of Mines and Energy and PERTAMINA). The Ministry of State for Research and Technology is presently making preliminary plans for a major scientific data bank which will probably be located in the new Science and Technology Research Centre being constructed at Serpung, 40 km. east of Jakarta. Factual databases on energy and mineral resources and on ocean technology are seen as the first priority. Access will probably be limited at first to the institutions responsible for research and development planning in these areas but the data bank should later be accessible to scientific community and other interested sectors of the public.

4.1.4 Access to international databases

Internationally there are now nearly 900 bibliographic and factual databases available to on-line users through more than 150 host computers which are almost entirely located in Europe and North America (20). In addition to being accessible through public data networks, most of the major hosts can be reached, although at higher cost, through the international telephone and telex networks.

None of the libraries in Indonesia is presently equipped with computer terminals for access to databases abroad. PDIN, however, hosted a ten-day demonstration of on-line telex access to foreign databases in January 1982, and is planning to initiate such a service on a regular basis in the near future. The national news agency, ANTARA, has arranged for on-line access to an international database on currency exchange rates through a leased voice-grade channel to Hong Kong. In the near future twelve major banks in Jakarta will receive information from this system and also provide input by means of terminals connected by leased lines to ANTARA.

Since systematic access to information generated abroad is now ensured almost entirely by 'traditional' information services, it is useful to review the extent of use of these resources as a rough indicator of demand for on-line services. A major difficulty retarding the access of specialists to information generated outside Indonesia is the low availability of major international indexing and abstracting journals. In 1974, only 329 titles among the world output of 1985 secondary journals were subscribed to in the country, and many of those are available in only one or a very limited number of copies. PDIN holds 115 titles, and only two other centres maintain subscriptions to more than ten. About fifty special libraries and university libraries provide manual current awareness services based on their own acquisitions and on available abstracting and indexing journals, and approximately the same number conduct manual literature searches for users upon request. PDIN handles 300-500 requests per year for literature searches annually, mainly from researchers in the public and private sectors; among the most common fields of interest of these requests are medicinal plants, energy, appropriate technology, pharmacology and industrial chemistry. Only about 5-10 requests annually are redirected off-line to specialized foreign information centres, usually by telex.

The main factors preventing the introduction of on-line retrieval services by the libraries and information centres of Indonesia are seen as the high cost of telecommunications and the related problem of ensuring sufficient revenues from users to support such services. It appears that many potential end-users of international indexing and abstracting journals in the universities, the research institutes and industry are unfamiliar with this type of traditional bibliographic database or do not yet consult the available journals regularly. Not surprisingly the few interviews conducted in the present study showed that user needs for on-line access to international information sources cannot easily be quantified at present and should rather be seen as building up gradually in parallel with use. Discussions with potential user institutions involved in R&D brought out considerable user interest, but also a lack of awareness of the services that could be provided thgough on-line access. Workers in one

advanced research institute apparently felt that they obtained sufficient information from informal contacts with colleagues in the developed countries, but even in such cases there will be a need for back-up services which can verify that all available information has been identified. The national news agency, ANTARA, felt that access to foreign databases would greatly help in providing needed background information for journalists and editors.

According to the 1981 Unesco Statistical Yearbook (21), there were already 7645 scientists and engineers involved in R&D work in Indonesia in 1975, including about 4700 in the universities, about 2800 in central government services and about 100 in the productive sector. In the short to intermediate terms all of these researchers, as well as post-graduate students who number more than 1700 (19), should be considered as potential users of on-line information services. On the other hand the experience of the developed countries (22,23) indicates that, assuming telecommunications charges could be reduced to those prevalent in Europe and North America (US$10-20 per hour of on-line connect time), several hundred search requests annually would suffice to justify the setting up of an on-line service in an existing library or documentation centre through the acquisition of a terminal and assignment of one or more specialized documentalists to operate and promote the service. On this basis the establishment of an on-line retrieval service in each of the specialized information networks in Indonesia, as well as in each of the university centres of excellence, is certainly indicated. In the longer term the other user groups such as other university-level teachers (totalling nearly 47,000 in 1976 (21), planners, economists, physicians, lawyers and ultimately undergraduate students would be in position to use and greatly benefit from this type of information service, particularly if decentralized access from their place of work or study becomes possible.

It must be stressed, however, that international bibliographic databases are only useful if the national information system can provide the original documents which are identified. The growth in demand for on-line access will thus be very limited without commensurate development of national document delivery capability. It should also be noted that, although wide on-line access in Indonesia may eventually enable a reduction in subscriptions to expensive hard copy indexing and abstracting journals, the demand for these journals may also increase as users become more aware of their utility, particularly for providing full abstracts which are frequently not available from international databases.

4.1.5. Regional cooperation

A number of Asian countries have, over recent years, supported the gradual development of a regional network* for sharing specialized information resources, as a means of supplementing and strengthening their own national scientific and technological information systems. This cooperation has been particularly fruitful among the five countries of the Association of South-East Asian Nations (ASEAN) - Indonesia, Malaysia, the Philippines, Singapore and Thailand - which share a strong and growing political and economic linkage. Among the several cooperative information activities in Asia of interest to Indonesia one should mention:

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* The term network as used in this section refers to a complex of institutions, individuals and procedures in the information field which is coordinated toward the achievement of fixed objectives. An information network may or may not make use of telecommunications technology as a medium for information transfer.

- the consortium of PDIN and the National Libraries of the other ASEAN countries (NLDC-SEA) which is cooperating in the exchange of information and studying the establishment of a computerized regional bibliography;

- the Regional Centre of the International Serials Data System (ISDS), located in Bangkok, which is developing a computerized database of periodicals published in the ASEAN countries;

- a sizeable number of specialized information networks and centres, such as Technonet Asia (covering information for industry) headquartered in Singapore, the Agricultural Information Bank for Asia (AIBA) located in the Philippines and the Regional Mineral Ressources Development Centre (RMRDC) in Indonesia, several of which are already developing computerized operations.

In addition, a number of bibliographic and factual databases are being set up or are already operational at the national level in South-East Asia, within private institutions such as the Asian Institute of Technology in Bangkok as well as within national information systems. Two of the ASEAN countries, namely the Philippines and Singapore, have already established their own permanent data communications gateways for information retrieval from databases in the industrialized countries, and a similar project is under study in Thailand.

In view of the need expressed by the countries of the region to promote further cooperation in the information field, Unesco arranged a meeting of experts named by the Governments of China, Indonesia, the Republic of Korea, Malaysia, the Philippines, Singapore and Thailand in 1980 to plan a Regional Network for Scientific and Technological Information in East and South-East Asia. A programme of Network activities, which involve the coordinated development of national information systems, support for regional information centres in certain priority fields, and collaboration in utilizing technologies such as telecommunications for information transfer, has been developed, and, international financial assistance is being sought for its implementation (24). The concept of a regional information network was endorsed by the Second Conference of Ministers Responsible for the Application of Science and Technology to Development and those Responsible for Economic Planning in Asia and the Pacific (CASTASIA II), which was convened by Unesco in Manila in March 1982, and efforts are already underway to extend the framework of cooperation from the seven countries originally involved to other interested Member States in the region.

In addition two global network projects, which concern a large number of developing countries, are being proposed for initiation in the near future. The first is the International Databank for the Non-Aligned Countries (IDNAC) which may be established in Sri Lanka. Besides providing documentation on the non-aligned movement, this centre would serve as a host for several priority databases produced in the industrialized countries, and would ultimately aim to provide on-line retrieval services on a favourably priced basis to developing countries which could set up the necessary international telecommunications links (25).

The second international proposal, sponsored by the United Nations Development Programme (UNDP), involves the creation of a Development Information Network (DEVNET) which would employ dedicated international telex channels to transmit current information covering international trade and finance, tender offers, upcoming events and certain national

achievements and development activities in a 'press bulletin' format. The network structure would ultimately include a national centre in each of sixty developing countries to collect and disseminate information, six regional centres to edit and retransmit the regional output and an international centre concerned with management, inter-regional transmission and archiving. Users in the sixty participating developing countries would receive information emanating from the other countries through their national centres by postal channels or telex-type facilities at the national level (26). Although the technical planning for DEVNET is still at an early stage, it is expected that the network would make maximum use of existing national and regional facilities for press bulletin transmission (see section 4.3).

DEVNET would operate on a non-profit basis, and, in order to be economically viable, it will depend on subsidized transmission tariffs to be arranged by the participating countries. It should be stressed that DEVNET has been designed as a one-way current awareness teletype service and that it will not permit users to interrogate foreign databases on-line. It may well be possible, however, for the national authorities in any given participating country to arrange for the sharing of internal transmission and international gateway facilities between DEVNET and data communication applications such as information retrieval.*

The major point to be taken from the above situation is that the developing countries in general, and particularly the countries of the Asia and Pacific region and of ASEAN, share many common needs for specialized information and for information transfer facilities. Decisions on a strategy for access to national and foreign databases in Indonesia should therefore take account of possibilities for regional cooperation and sharing of resources.

4.2 Organizational information

Most of the data communications applications in Indonesia in the near future will undoubtedly involve the internal data needed for administration, operations and planning within enterprises and government. These applications can basically be grouped within two categories: computerized on-line data processing and retrieval and terminal-to-terminal tele-informatics services (teleconferencing, telewriting, telecopy service, electronic mail, tele-alarm, etc.). In analyzing the needs and resources for these types of data communication, the present study included a review of the present computer communication applications in Indonesia and a survey of the situation as seen by institutions in four major potential user sectors.

Precise information on the quantity and types of computers in Indonesia is not available from published surveys due to the rapidly growing number of installations. As of late 1980, there were more than 320 mainframe and mini-computers in the country, installed principally in the following categories of institutions:

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* In the period ensuing since the preparation of this report, plans have advanced to test the DEVNET concept in a pilot project known as TIPS, which would concentrate on technological information and involve a much smaller number of countries than foreseen for the full network.

- Central government and public services (Ministries such as Public Works, Defense and Finance; Central Bureau of Statistics; pension funds; transportation; research institutes; etc.)
- Provincial government
- The universities
- Banking and insurance
- Mining (including petroleum) and heavy industry
- Private manufacturing and commerce.

One can attribute the use of essentially all this equipment to 'organizational information' applications as defined above, since the use of computers in specialized information services, in research and in automation is not yet widespread in Indonesia. User institutions in the first five of the above categories, falling almost entirely within the public sector, account a very large percentage of the computer installations. Most installations are still situated in Jakarta, but large computers have now been acquired by all the major state universities and most of the provincial government headquarters. The growing availability of inexpensive mini- and micro-computers is rapidly encouraging decentralized processing and acquisition of computers by smaller organizations. Most computers are presently available only to the host institution although several big public sector computer centres make excess capacity available to other public sector users. There are only a very few local companies which rent their computer facilities to small private users. In the late sixties the Indonesian government established an agency called BAKOTAN to coordinate computer use in Indonesia, but, due to limited resources, its role has essentially been limited to advising on computer acquisition in the public sector. There are only about nine enterprises in the country which are specialized in undertaking software development for projects, and there is in general a lack of qualified specialists in computer operations and software development (27).

Although time sharing and on-line processing are being introduced with increasing frequency, the majority of computers in Indonesia still rely on batch processing methods. In 1978 there were only 22 computers equipped for on-line access, to which were connected 229 on-line terminals (14). The number of leased data communications lines set up annually by PERUMTEL is still relatively small (four in 1978, nine in 1979 and six in 1980), and there was a waiting list of 46 at the time of the mission.

The national petroleum company, PERTAMINA, is the largest telecommunications user in the mining and industrial sector and one of the largest single users in the country. It maintains extensive private networks of leased lines and radio terminals for transmission of voice, facsimile, telex and data, and has an annual budget for leased lines from PERUMTEL approaching one million US dollars.

Data communications, which were started about five years ago, are now employed in various applications such as marketing, inventory control, finance and refinery operations. The main data communications network branches out from the PERTAMINA headquarters in Jakarta, where three computers are installed, to seven terminals in Java and one in Sumatra; there are plans to install connections to nine further sites dispersed throught the country by 1985. In addition there are two specialized local

networks for production control which radiate from refineries in Cilacap in Java (three lines) and Plaju in Sumatra (four lines). Computer terminals are rented from a major computer equipment supplier. Data transmission is generally limited to 1200 b.p.s. (the maximum capacity of most of the leased lines) and takes place mainly during office hours. PERTAMINA also has arranged international leased lines which enable two specific contractors to transfer data between Indonesia and own their foreign computers (one located in Europe and the other in North America).

It is often found quite difficult to lease voice-grade lines outside the Jakarta area, and, when no lines are available, PERTAMINA sometimes takes responsibility for building the necessary earth station in exchange for preferential tariff treatment on the lease of the line in question. Some leased facilities for voice and telex have recently been given up by PERTAMINA as the public switched telecommunications networks improve, and it is felt that a future public data network would be very helpful for reducing the costs of, and extending, the internal data communications of the company. There is apparently no need at present within PERTAMINA for developing data communications links with other organizations located in Indonesia or abroad, with the exception of the dedicated international connections mentioned in the previous paragraph.

Garuda, the government-owned national airline, handles both domestic and international traffic and is the largest Indonesian air carrier. It has an extensive private telecommunications network, consisting of leased telex and voice-grade lines, radio links and a multichannel microwave link between Jakarta's two airports; it is also a major user of the public switched telephone and telex networks. The company's telecommunications budget for 1981 was nearly US$ three million including more than US$100,000 for data and telex lines leased from PERUMTEL.

Three large computers are presently installed in Garuda's headquarters in Jakarta, two of which operate in on-line mode; two of the machines will soon be replaced with more modern equipment, after which all three computers will support on-line applications. The main Garuda application requiring data communications in Indonesia is the airline reservation service, for which connections are maintained between a computer in Jakarta and the reservation offices. Presently voice-grade leased lines and VDU terminals provide the connections to eleven travel agencies in Jakarta and to airports in six major cities, while computer-switched telex links serve the remainder of the country's 32 airports. Other computer applications such as maintenance control and accounting are presently limited to in-house operations in Jakarta. Data terminals are bought from abroad and maintained by the local office of a large multi-national computer equipment supplier. International data communications are limited to participation in the international SITA (Société Internationale de Télécommunications Aéronautiques) reservation network, to which the Garuda computer centre is connected through a 4800 b.p.s. leased line; each participating airline is charged according to the number of messages it sends on the network.

Although a few more data communications links will be needed between Jakarta and major Indonesian airports, telex connections are seen as sufficient for reservation services in the smaller airports. There is apparently no need foreseen by Garuda for international data communications other than participation in the SITA system, or for new domestic

tele-informatics services. The principal problems encountered in domestic data applications are difficulties in ensuring line quality and the high cost of leased lines; a public data network is seen as being very useful if it would help to reduce these obstacles.

Bank Indonesia (the Central Bank) has its Head Office in Jakarta, 27 branch offices in Indonesia and 5 representatives abroad. It is a very heavy user of the public switched telecommunications networks, and particularly of the telex network through which nearly 400,000 messages are sent and received annually on terminals in the Head Office. A private radio network which was previously used extensively for communication among the Bank Indonesia offices now serves essentially as a back-up to the public telephone and telex networks.

The computer of the Bank Indonesia operates in batch mode, as do those of most the Indonesian banks. The question of installing an on-line accounting system with decentralized terminals has been considered, but such a system is seen as improbable in the immediate future due to the costs involved. No particular problems are experienced in the transfer of financial and economic data at the regional or international levels, and telex facilities are generally seen as adequate for this purpose. The Bank would, however, be interested in exploring the use of teleinformatics services such as facsimile transmission, teleconferencing and tele-alarm in the future, and the officials interviewed felt that an association of major telecommunications users might prove helpful in recommending future improvements in the national telecommunications system.

The 43 state universities and numerous private institutions of higher learning in Indonesia require their own types of 'organizational information' for administration, teaching and research. These institutions are very widely dispersed geographically and differ greatly in their levels of development, with the oldest and strongest universities being located on the island of Java and the newest, least experienced ones generally located in the more remote areas of the country. In view of this situation, telecommunications are seen as a promising means to promote the exchange of information resources among universities, and a pilot project is presently being planned by the Centre for Communication Technology (PTKPK) within the Ministry of Education and Culture and several other cooperating organizations in order to link nine university campuses on the eastern islands of Indonesia (Kalimantan, Moluku, Sulawesi and West Irian) via the PALAPA satellite to the Agricultural Institute (IPB) in Bogor near Jakarta. The project, which is scheduled to start in 1982, will test various communication techniques in remote teaching, consultation on research, educational policy coordination and sharing of library and information resources in the area of agriculture and rural development. The principal method of communication will be audio teleconferencing although other techniques such as 'electronic blackboards' (telewriting), telecopy services, and slow-scan video transmission will be tested, as well as possibly some TV transmission of lectures. All of the sites except Bogor are already equipped with an earth station which would enable them to participate in the experiment, so that the cost of equipment for the project will be relatively modest (28).

Consideration does not seem to have been given to data transmission needs in the context of the project, either for library networking purposes, for interrogation of foreign databases, or for computer resource sharing. If these applications are to be incorporated in the future, it would be useful to study as soon as possible the feasibility of employing common transmission facilities and compatible equipment for the two types of application.

The use of data communications for the transfer of 'organizational information' is increasing rapidly in Indonesia although it has been relatively limited up until now. It has been seen that public tele-informatics services in Indonesia are still essentially limited to planned or experimental projects, and several public enterprises and agencies are already beginning to establish private data communications networks, largely for want of appropriate public facilities. The remainder of Indonesia's 1.2 million registered businesses will undoubtedly also begin to make use of distributed data processing and data communications as host computer services and data communications facilities become available. It is clear that the demand for appropriate public computer-to-computer, terminal-to-computer and terminal-to-terminal data services is potentially very much greater than the immediate needs indicated by the few major current users of data communications in the country.

4.3 General information

In view of the priority accorded by the Government to raising the living standards and knowledge of the population, and to promoting an equitable distribution of welfare, the transfer of information to the general public and to target groups without higher education is particularly important in Indonesia. Various traditional means and new technologies are already being used to promote information transfer to these groups through education, extension services, public libraries and the mass media. Radio and television transmission facilities are being expanded by the Ministry of Information in view to reaching all areas of the country, and techniques for radio and television broadcasting by satellite are under consideration in this context. In addition to radio and TV, newspapers, films and personal contacts through information officers are presently used in the Government's programmes for public information and extension work. Teletext and videotex are seen as having a potential major role in information transfer in Indonesia, especially in providing information in suitably packaged form to the rural communities, and the concept of public data communication facilities is seen within the Ministry of Information as a means to help these technologies to play an active role in the future. Remote electronic printing facilities are under consideration as a means of publishing a news magazine in the ASEAN region.

In the area of education, radio, TV and various audio-visual media are being tested in experiments in distance teaching in the rural areas. Plans are also under development for an 'Open University' which would make heavy use of instructional kits and the broadcast media in reaching students who would not otherwise have the opportunity to receive a higher education. Teletext and videotex have apparently not yet been seriously considered as future educational tools in Indonesia, although their potential is certainly as great in this area as it is in public information services, particularly for videotex which could ultimately provide interactive guided learning and information retrieval for individual students.

A national public library system is gradually being created with the support of the Centre for Library Development within the Ministry of Education and Culture. Provincial public libraries have now been established in all but one of the provinces and they in turn are participating in a two year old programme to organize public library services at the regency level. Nearly every regency now has a public library and it is planned to equip each one with a mobile library unit to reach readers at the village level. Since 1981, all new schools in Indonesia must have libraries, and pilot projects for school library development have been initiated in 16 provinces in view to extending them to cover all provinces in the future. A publicity effort, including television programmes and films,is being undertaken to encourage use of the public libraries by the population which is not yet very familiar with such facilities. A programme to install video-tape units in the public libraries is underway, and it is expected that non-print materials will become increasingly important in providing information to weak readers or non-readers. There are at present no computer or data communications applications in the public library system, but the need is seen for a database and communication system for library management and ordering of foreign books. Telex is presently considered too expensive for inter-library communication, and the private radio network of the Ministry of the Interior must sometimes be used for urgent requests.

The national news agency, ANTARA, maintains a private computer-switched telex network connecting its Jakarta headquarters to offices in each of Indonesia's provinces for its domestic press bulletin services. Most of the traffic is from Jakarta to the provinces, and is despatched during two daily periods of three-and-a-half hours each; there is also a small traffic of press bulletins from the provinces to headquarters and some use of the network by the Ministry of Information for communications with its regional information offices. ANTARA receives a preferential tariff for leased telex channels, but this is several times higher than the special press bulletin rates accorded by telecommunications administrations in several other Asian countries. Although there is potential interest in making use of a future public data network for press bulletin services, this would only be possible if there were assurances that no delays in transmission would occur. There will in the future be a need to reach every inhabited island through the press bulletin network. There are presently no plans for a computerized storage and retrieval facility for domestic press bulletins. Facsimile services have not yet been used by ANTARA, but could be very useful for transmission of news photographs; present plans envisage the establishment of a domestic radioteletype (RTT) network for wirephoto services, but this is a relatively slow method requiring about fifteen minutes to transmit a single picture.

ANTARA also maintains a number of leased international telex lines for exchange of information with foreign news agencies, including connections to the capitals of the ASEAN countries (except Singapore which has no national agency), satellite links to New Delhi and Hamburg, and a planned connection with the Islamic International News Agency in Jeddah. It also uses RTT equipment for exchange of news items with Europe and Japan, and acts as a redistribution centre for news from the Non-Aligned News Pool in Belgrade and the OPEC News Agency. In general, all the agencies affiliated

with CANA (the Organization of Asian and Pacific News Agencies) are interconnected by telex-grade channels, and pool their resources to enable each member to transmit a limited number of press bulletins to the other agencies. This type of regional cooperation is expected to develop further in the future, and is being promoted actively within the Unesco programme in the communications area. As in the case of the domestic services, improved public telecommunications services could ultimately be useful for news transmission at the international level, provided that sufficiently low costs and high reliability could be ensured.

Although data communications techniques, and particularly videotex, have a great potential for bringing information to the general population in Indonesia, this potential can only be realized after extensive study of the most appropriate technologies to be applied, followed by considerable investments. It is unlikely that data communications for the general public will become feasible in the short term, but it is important that possibilities for future developments be taken into account in planning more immediately realizable applications concerning 'specialized information' and 'organizational information', as discussed in sections 4.1 and 4.2. In the nearer future, telecommunications advances may, however, help significantly in the management of 'general information', for example in the work of the national news agency or the public library system, which will indirectly improve information transfer to the end-users. The potential demand by the public for use of standard data communications services such as telex and facsimile terminals installed in post offices or other public centres should also prove to be significant in the intermediate term.

V. National strategy options

5.1 Development strategy for a National Packet Switching Network (NPSN)

The review of needs in the previous chapter shows that there is a sizeable demand for data communications within Indonesia as well as considerable potential demand for access to data outside the country. In the near future high capacity facilities for data transmission at the national level will increasingly be required, mainly for internal purposes, by a large number of major administrations and enterprises. The other sectors of society, which consist of large number of relatively small information users, are presently unable to use telecommunications to gain access to data needed for the development of the country because of economic constraints, lack of facilities and insufficient awareness of the potential benefits of data communication services. Connections to external data networks,and later to national databases, would be particularly useful in stimulating the transfer of specialized information such as scientific and technical information for decision making, research activities and post-graduate education. For these reasons, it appears necessary to establish quickly a public data network, tentatively called the National Packet Switching Network (NPSN) in the present report.

Because of the large investments and the organizational difficulties in setting up a public data network, the NPSN would have to reach the different categories of users and geographic areas (see Chapter IV and figure 1) on the basis of a multi-stage long-term development strategy which takes account of technical constraints, commercial interests and national development priorities. Such a strategy is already under development in Indonesia on the basis of consultations involving the telecommunications administration, the national planning agency, the authorities responsible for supervising the flow of information and for production and acquisition of informatics equipment, as well as user representatives. Several general aspects to be taken into account in developing the NPSN are outlined in the present section while other more specific elements are treated in the remainder of this chapter. For the sake of completeness and general interest, basic aspects, which are already well known to the Indonesian telecommunications administration, are included; therefore, the options described should be seen as directed to the general readership, particularly in the developing countries, rather than to the Indonesian authorities.

In many countries responsibility for development of the national data network and for commercialization of data services has been vested in a special unit or semi-autonomous agency which, although linked with the telecommunication administration, works in close contact with all of the national authorities concerned by information and data transfer. This approach is one which allows the NPSN to be developed within the overall national telecommunication system while ensuring its maximum responsiveness to user needs and market forces.

As a commercial strategy, a first goal would be to transfer the existing and planned computer communication applications of large national entities from leased lines to the national public data network. These large users would benefit greatly in terms of cost and quality of service by using a common network infrastructure, and some of them would probably open a part of their computer capacity for remote use by other organizations including medium and small companies. This in turn would stimulate the development of both publicly available databases and widespread use of

computers for 'organizational' functions such as inventory control, staff management and accounting. Ultimately, decentralized commercial applications in fields such as banking, insurance and credit services, already established in the developed countries, could be made available nationally in the main urban centres thanks to the operation of the public data network and its services.

This network strategy would be intended to progressively develop the potential data needs of the country while satisfying the major existing ones. It would also enable a large part of the required transfer of scientific and technical information to be financed by revenues from 'organizational' traffic which is likely to be relatively insensitive to tariff levels. Such a commercial strategy obviously presupposes a major effort in contacting business and administrative users and in developing the services they need. It should also be designed taking full account of the effects of data communication services on other national telecommunications services and their revenues.

Certain priority users of the network, such as requesters of specialized information in universities and research institutes, may not be in position to pay the full transmission cost for needed data, at least until the usefulness of remote access to such information is tested and proven to them. One solution to this problem which is administratively simple and equitable would consist in having call charges vary according to the day of the week and time of the day, allowing these clients to make use of the low tariff periods. The national operating organization of the data network would first have to determine the busy hours of the traffic, and then decide on a reduction of fees outside that period. The proposed reduction could be as great as 50%, for example, in order to stimulate demand and to encourage use of the network outside the busy hours. One should note, however, that this solution has not proved a success in the EURONET project. It may therefore prove necessary to grand direct subsidies to certain users or their institutions, at least for an initial period.

Some additional points should be considered in planning the initial implementation of the data network:

- terminals need to be as inexpensive as possible and to be available to users on short notice;

- the terminals have to be standardized and approved by the telecommunications authorities concerning their transmission speeds, their operational principles and their origin (e.g. from national and/or foreign suppliers); procedures for authorization of terminal equipment must be decided upon and clearly publicized;

- the number of users should be relatively large in the first year of operation;

- an announcement of the opening of the network and of the tariff stucture needs to be published about two years in advance in order to enable public agencies and private users to plan in due time their subscription to services, their training courses, their terminals and their investments.

5.2. Telecommunications technology for the NPSN

It is clear that the experimental Indonesian packet satellite data network (PACKSATNET) described in section 3.2, which will soon be in operation, should be given very serious consideration as a starting point for development of the future national public data network. This approach would, however, require steady and very extensive enhancements in the number of customers per earth station and in the the number of earth stations, as well as improvements in channel capacity, establishment of external connections and introduction of new data services. These enhancements, which are already envisaged by the national telecommunications authorities, would in turn require modifications of the software and hardware at each network node implying interruptions in service and the need for well-prepared technical staff at each site, in addition to the costs of developing or acquiring the needed network technology.

Although the basic caracteristics of PACKSATNET are already well understood, it will not be possible to undertake a detailed analysis of the problem of extending the network before its initial operational performance and technical limitations become known. By early '984, a measurement campaign could be expected to enable such a study by providing data on how to implement the following connections and services at the lowest cost:

- interconnection of any two customers among the maximum possible number of customers (N) in the pilot data network

- interconnection of any customer of the Indonesian data network to any customer of a foreign public data network (complying with the relevant CCITT recommendations)

-increasing the maximum value of N (the number of domestic customers in the data network) and S (the number of the earth stations) while maintaining the best quality of service

- operation of additional telecommunication services such as telex, facsimile and public data retrieval facilities on the network.

The study would examine these questions from several viewpoints to provide guidance on diverse aspects: the technical feasibility of different enhancement techniques, adaptations required in the present PACKSATNET hardware and software, a smooth enhancement schedule making full use of available resources with minimum disruption in service, implementation costs, operating aspects, maintenance, as well as further possible long-term enhancements. The possibility of sharing expensive facilities like earth stations between the data network and other telecommunications services would also be examined.

It seems particularly important to consider means of extending the number of earth stations and the operating capacity of PACKSATNET which are at present held back by the performance limits of the unslotted ALOHA capacity assignment scheme (see section 2.3). The choice of a capacity assignment scheme for satellite packet transmission depends on several

factors, including the types of services to be provided, the traffic to be carried, the number of earth stations and the traffic matrix, all of which in turn depend on the number of users and their distribution. The work accomplished within the SATNET project (see section 2.4) indicates that there are very good possibilities for improving the assignment scheme, and it is therefore essential that the study take account of the results of SATNET as well as the PACKSATNET experience.

The results of the study would enable the Indonesian authoroties to make some critical policy choices on development of the NPSN on the basis of national priorities. If the conclusions of the study demonstrate that the internode links of the future data network can make use of the earth station-satellite paths allowed by upgrading the basic PACKSATNET software, all the new data and tele-informatics services in Indonesia could be based on PACKSATNET. For example, there would be no need to implement a specific network for a fast telex service, since the data network could provide such connections at low costs.

If the conclusions indicate that costs and technical difficulties render this approach infeasible in the near term, it would then be opportune to open two different classes of services:

- one specific service for interactive protocol users (e.g. on-line information retrieval), which would employ terrestrial circuits to ensure short transit delays, and

- another service to provide channels for non-interactive uses (file updates, telecopy, press photo, and so on) which do not require an instantaneous system response and which could thus employ the satellite connections.

The first service could later be integrated with the second when it becomes possible to make the appropriate improvements in the satellite data network.

In general it should be noted that a packet data network does not absolutely require digital lines. It suffices to use any kind of available and good lines. The national planners may thus choose to make use of traditional telephony procedures for many data links, even if the basic data network design relies heavily on PACKSATNET technology. Since radio links are subject to micro-breakdowns depending on the atmospheric conditions, it may be convenient to avoid or reduce the problem by using cable circuits. For average and long distance paths the use of two lines in a multiline procedure is helpful since it ensures a back-up line in case of failure. A technique which may prove more useful is the interconnection of high speed digital devices through coaxial analogue transmission facilities by means of a 'data over voice' (DOV) channel.

5.3 Improvement of access to PACKSATNET through PSTN connections

In the coming years, the number of available circuits in the public switched telephone network(PSTN) and the quality of circuits will steadily increase. This trend should permit access to the gates of PACKSATNET from asynchronous terminals via PSTN connections following the X28* CCITT recommendation. With this improvement, each urban centre or group of centres would have a single earth station routing the inter-urban data traffic by satellite, while local data traffic would be handled locally.

* see glossary, Annex 8

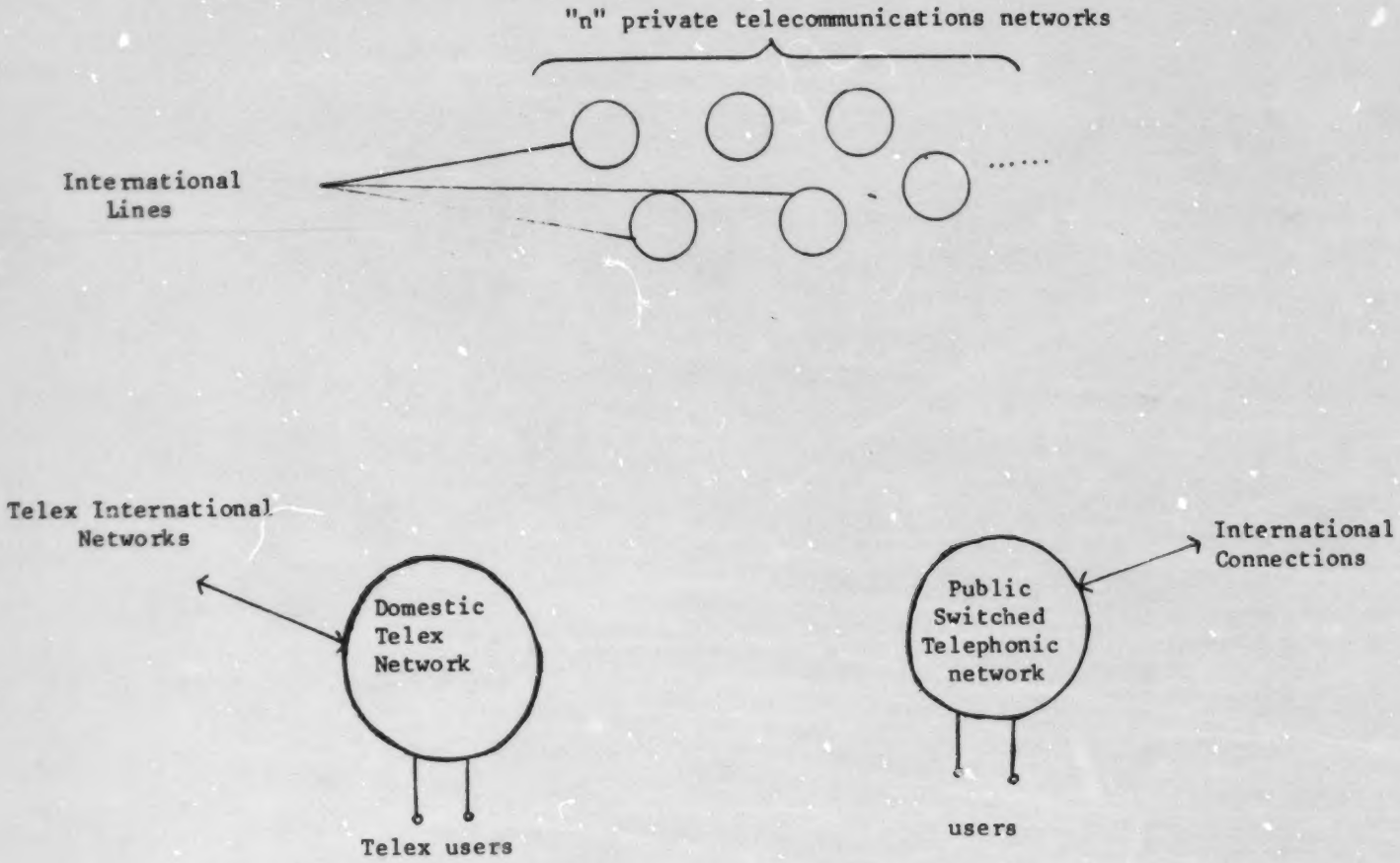

FIGURE 4 : PRESENT SITUATION CONCERNING TELECOMMUNICATIONS SERVICES

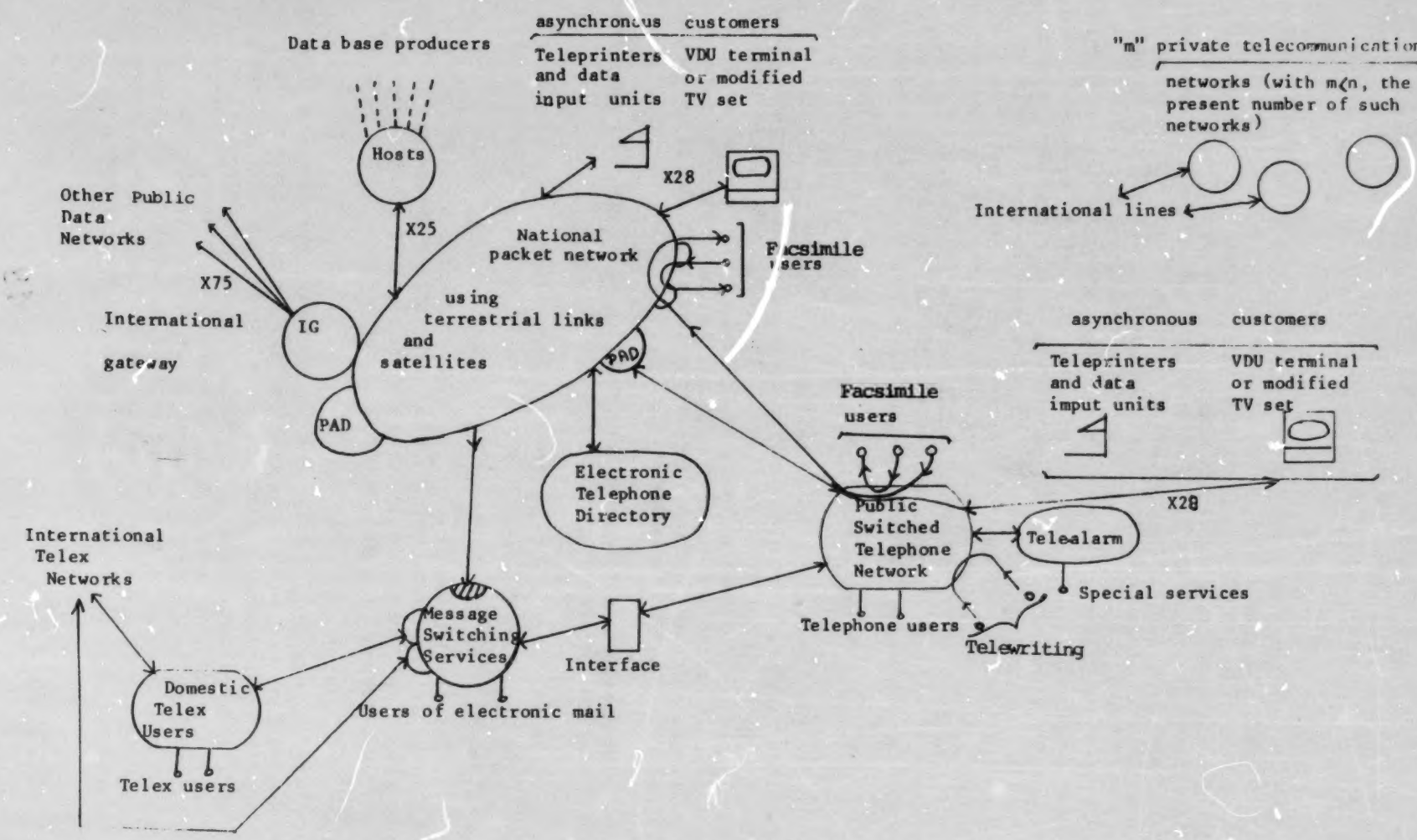

FIGURE 5 : PROPOSED MODEL FOR FUTURE TELECOMMUNICATION SERVICES

Figure 3 shows diagrammatically the suggested scheme for PSTN access to PACKSATNET. The practical results obtained in the PACKSATNET experiment should be useful in deciding on the technical feasibility of this proposal for extension of the network. By increasing the capacity of PACKSATNET itself and linking it the PSTN, an embryonic public data network would be immediately available, which would in turn facilitate the opening of new data services at low cost and a progressive transfer of private network and telex traffic onto the new facilities (see figures 4 and 5).

If the quality of the PSTN connections cannot be improved enough, it would be necessary to reduce the bit rate of the data terminals (to 600 bauds* for example). For this reason a measurement campaign needs to be undertaken throughout the country to learn whether the long distance terrestrial links, the switching centres and the local networks are able to support the planned data services. The regulations on data transmission by PSTN connections would need to be revised in order to allow the use of modems* equipped with acoustic couplers* for PSTN data connections from asynchronous customers to the future data network.

5.4 International data connections

It would not be reasonable to limit the use of the National Packet Switching Network to domestic applications, since data communications between users in different countries will undoubtedly become important for most fields of national activity in the future. There is already a significant demand for access to specialized information in foreign databases, which could be arranged very economically by packet transmission to external public data networks.

International data connections from Indonesia could be established by one of two different approaches:

- installation of an international gateway, in Jakarta for example, enabling direct connections to any external public data network (EURONET, TYMNET, etc.), or

-installation, again perhaps in Jakarta, of a concentrator linked to a foreign international gateway associated with a single external data network; such a concentrator would depend on the foreign gateway for traffic management and thus would be a sort of node of the external network.

An international gateway can handle a much greater amount of national data traffic than a concentrator since it is generally associated with a packet switching exchange (PSE)* which can be linked to the national public data network and to synchronous customers working with the X25* protocol as well as to asynchronous customers. Although PACKSATNET has been designed to enable any node to serve as an international gateway as well as handling a limited number of PSTN connections, it may well be expedient in view of the expected volume of PSTN calls to external networks to install an additional PSE to serve as an entry point to the

* See glossary, Annex 8

gateway as well as to PACKSATNET and the future NPSN. Generally speaking, a PSE which currently costs about US$25,000 should comply with all CCITT* recommendations. Packet assembler-disassemblers (PAD's)* , connected to either a PSE or a concentrator, are required to receive data calls from ordinary leased lines, dial-up asynchronous customers or telex customers. The cost of a seven port PAD (ASCII or Baudot code) is about US$11,000, while a fifteen port PAD costs about US$13,000.

The figure below reviews the characteristics which distinguish a gateway from a concentrator:

FIGURE 6: DIFFERENCES BETWEEN AN INTERNATIONAL GATEWAY AND A CONCENTRATOR

Characteristic	Concentrator	International Gateway (IG)
Number of international connections	One only, to specific external international gateway	No limitation in number
Billing and management of operations	Handled by the management centre associated with the remote IG	Handled by associated national management centre
simultaneous domestic connections	(up to about 16)	A large number (perhaps 200) on the associated packet switching equipment
Approximative costs (excluding PAD's and modems)	US$25,000	US$33,000 for IG; US$15,000 for the management centre; US$25,000 for PSE

The Philippines and Singapore have each already installed a TYMNET node, which is a sort of international gateway that provides for low-cost data links (about US$ 15 per hour of connection) to the networks connected to TYMNET through its Supervision Centre in Cupertino (California, USA). A TYMNET node installed in Indonesia would thus allow customers to make connections with TYMNET, TELENET, DATAPAC or the French TRANSPAC network, but not for example with EURONET. As mentioned earlier a true international gateway allows data connections to all external networks; it can also handle other sorts of traffic such as telex, facsimile and voice once they are converted to the appropriate packet format.

From the above considerations, it appears that the most appropriate solution for international data communications in Indonesia is the establishment of a true international gateway for data, since only this approach will allow for future as well as present needs. In view of the immediate need for economic access to external data bases, the national authorities might well find it worthwhile to first set up the international gateway and associated packet switching exchange in Jakarta to allow limited access to databases abroad by telex and by asynchronous terminals (the latter being connected via the PSTN and leased lines). This international node could later be integrated within the NPSN on the basis of the results of the PACKSATNET study.

All the equipment required for the international node is available within six or twelve months from any of a number of specialized manufacturers. If, as a first step, one restricted international data connections to PSTN and telex users in a limited area such as Jakarta only (as well as perhaps to the initial PACKSATNET users), the cost of the hardware (excluding modems) would be roughly:

1	International gateway.....	US$ 33,000
1	Management centre.....	15,000
1	Packet switching node	25,000
2	PAD units (with 7 ports each).....	22,000
	Accessory equipment*	5,600
2	Testing tools.....	50,000
	Total	US$ 150,600

In the above estimate prices quoted by three companies have been used, based on an exchange rate of six French francs to one United States dollar in March 1982 (FOB Paris, not including taxes). These costs have an indicative value only; they could be refined through a tender invitation organized by the concerned administration.

The installation costs would have to be discussed with the suppliers and would be related to the extent of the modifications required in the network software. Maintenance costs are generally high but can be reduced by using national expertise insofar as possible. Initial training for a small operational and maintenance team should also be foreseen; one month of specialized training in Europe (exclusive of travel and living expenses of the trainees) would cost approximately US$15,000. The cost of a stock of spare parts for the entire lifetime of the equipment should also be foreseen.

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* VDU terminal..... US$ 1,000
Line printer 300/1200 bauds..... US$ 3,000
Asynchronous visual display unit... US$ 1,600

The billing would need to be processed in batch mode outside the system on a large computer, for example using information recorded from the management centre onto a punch tape or a magnetic disk. The computer resources required would depend on the traffic load.

Other approaches to reducing the cost of international data traffic might also be considered. For example, even in the above proposal several users in a country such as Indonesia might have to simultaneously employ separate channels terminating 15,000 km away in the European countries in the case of ordinary telex communications or access to databases not connected to EURONET (see figure 7). One could thus study whether the installation of special telecommunication devices can lower the cost of international data transmission or if, at the same level of costs, one can provide the users with greater capacity and faster access to external hosts. Figure 8 shows that by installing virtual circuit switching nodes at a central point in Europe a low cost high volume data transmission facility to Indonesia could be established. The benefits that such a scheme involving two international gateways, presented in more detail in figure 9, would depend mainly on:

- the present costs of the lines in question

- the costs of the necessary additional hardware

- the present and expected flows of traffic (on the common path) including the telex traffic

- the costs of the lines from the choosen European international gateway to the relevant end connections in Europe.

This cost comparison can only be undertaken by a telecommunication administration when discussing with other partners (relevant national administrations and international organizations).

5.5 Telex aspects

Despite the absence of relevant CCITT recommendations at present, it seems evident that telex access to specialized databases (including those within the future NPSN as well as external hosts) needs to be considered carefully from both the technical and economic viewpoint. It would appear unnecessary to work towards a fast telex network if a public data network is to be implemented, offering more facilities (such as closed user group, error detection, speed conversion and flow control) at lower cost and making possible access to the international telex network. For similar reasons it may well prove convenient to transmit all or part of the ordinary telex traffic over the future data network. In Europe, the United Kingdom, Italy and France are already beginning to interconnect their national telex network and their national PSDN or intend to do so. Of course, if international telex communications are to transit by the NPSN, the packet network should be interconnected with the international telex network. It is likely that within few years CCITT will be establishing new recommendations on links between telex and public data networks, which are potentially of very great interest to the developing countries.

FIGURE 7 : LINKS TO EUROPEAN COUNTRIES
PRESENT SITUATION

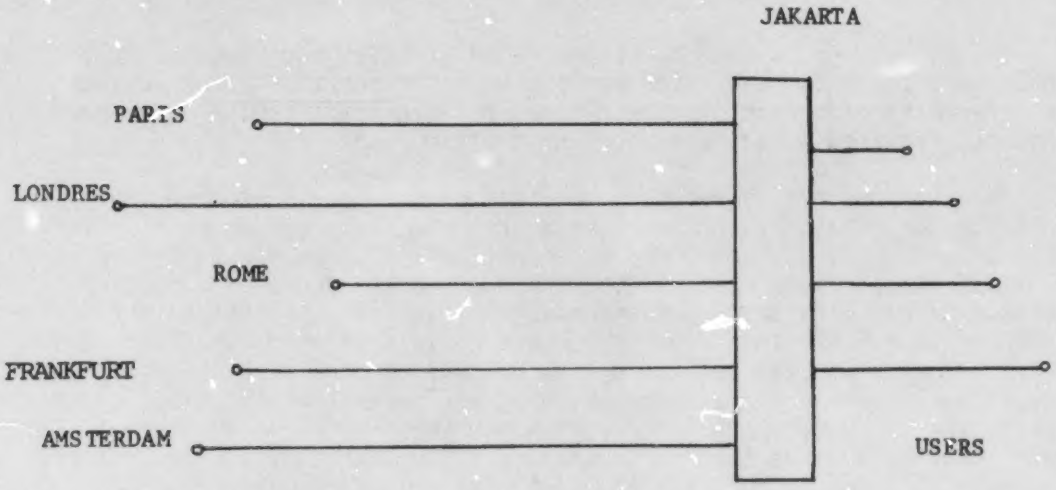


FIGURE 8 : EXAMPLE OF FUTURE LONG LINKS
TO EUROPEAN COUNTRIES

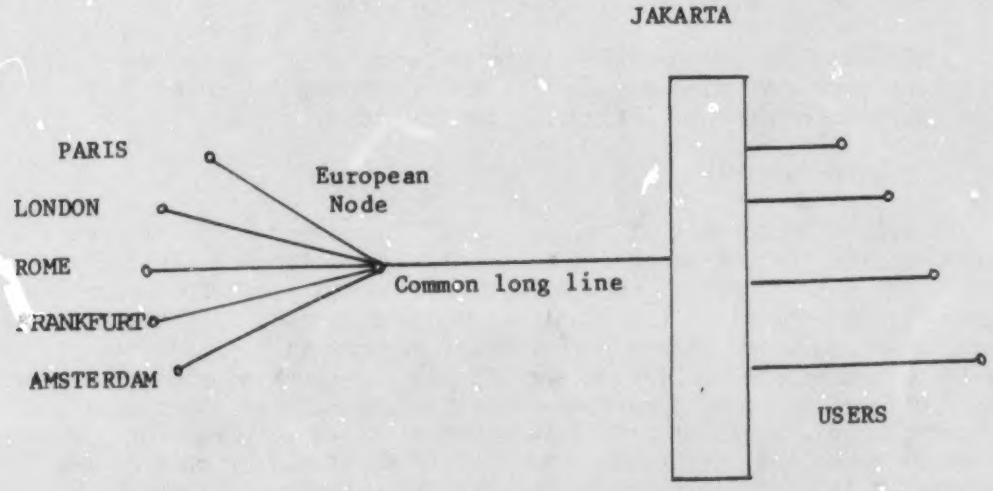
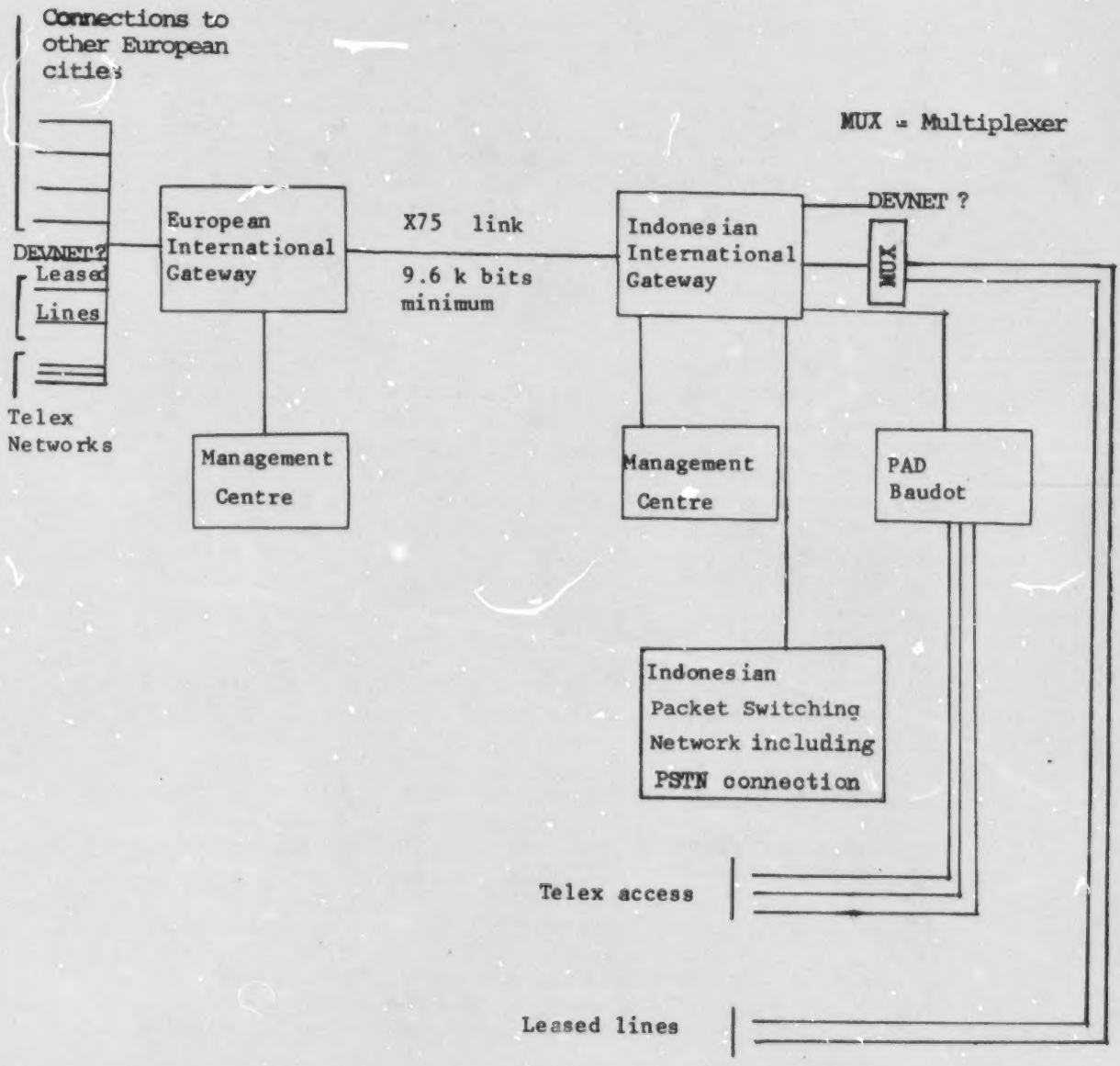


FIGURE 9 : POSSIBLE PUBLIC PACKET NETWORK INTERCONNECTIONS BETWEEN EUROPE AND INDONESIA



It has been suggested above that costs of international telex links could be reduced if a sort of sharing of the telex bit stream with data communications is implemented between countries. One should specify here that if there is a major cost reduction in this type of arrangement, the costs for telex users would not in general be reduced in the same ratio. It is important for the telecommunication administration to make profits in order to improve the network with new investment. Such profits could also enable the overall network to provide degressive tariffs for heavy use or special tariffs for certain uses such as scientific and technical information or press bulletins.

5.6 Operational aspects and maintenance

This very important subject requires at least a brief mention even if the technical details are outside the scope of the present study. A data network must provide good reliability 24 hours a day, seven days a week, which in turn requires a number of special monitoring procedures, maintenance tasks and back-up facilities. In addition, all circuits for PSTN access to the network need to be checked well in advance of the opening date, and afterwards many maintenance tasks will be necessary to ensure satisfactory public access. These problems have major financial and administrative implications for the planning and development of the network, particularly in the area of training of telecommunications personnel, which should be appreciated by officials responsible for information policy and by users.

The operation of a data network thus requires a special effort in maintenance. The staff need to be well trained in the matter of specialized circuits (non-switched telephonic circuits) and how to locate them (or their carrier equipment) within the relevant transmission facilities or the network plant area. They also need specific testing tools for locating any failure in a circuit or group path and to be familiar with their use. The measurements made during operations should always be compared with those performed when the circuit or group was set up for the first time.

5.7. Databases and computer facilities

It has been seen that a wide sharing of national computer resources within the NPSN could significantly promote national development by facilitating

- improvement of public administration and management of enterprises

- provision of information necessary for decision making, science and technology and ultimately the general public, and

- communication and execution of commercial transactions.

The number of computers to be connected to a data network can ultimately be very large if one considers all the services that a client could need:

- databases of research institutes, educational institutions and administrations

- public computer resources

- private computer resources

- electronic mail

- electronic telephone directory, perhaps with selected advertising

- external sources of information.

In order to control the access to the computers or ensure the confidentiality of certain data, either the host computer or the data network can provide passwords to admit only those clients who are allowed to receive a particular type or piece of information. At the network level, a 'closed user group' facility can be established to prevent users who are not authorized participants in a given private network application from calling members of the closed group.

In considering national or external database services the following definitions should be recalled:

- a bibliographic database contains references to documents covering specific subjects,

- a factual database contains data, facts or images required by users,

- a host (or data bank) maintains one or more databases in a computer and provides users with access to them through a standard interrogation procedure (user protocol).

Some rough guidance on the required number of hosts which provide specialized information can be given on the basis of experience in the developed countries. With the assistance of the European Economic Community (EEC), most of the ten EEC countries have now each established their own national host(s). A major problem comes from the strong competition among these hosts; frequently more than one contain the same kind of information, and most of them do not have enough users to cover their operational costs. The EEC countries have a total of 31 hosts, which is certainly a figure too high for the European market. It would therefore seem that Indonesia should not consider setting up more than one, or at the most two, multi-purpose commercial hosts in the near or intermediate future. There may, however, be a need for a number of other hosts which can provide very specialized services or serve a limited group of users on a non-commercial basis (e.g. within government administrations or the university library network).

As a first step, the responsible national authorities should consider the contents of future databases required to satisfy national needs for information in each sector of activity. Attention should be paid to the possibility of making use of certain priority external databases at the national level, taking account of the costs and delays in obtaining information abroad. Both bibliographic and factual databases will in general be required and their evolution might follow the three stages of implementation and use outlined below:

FIGURE 10: TYPICAL DEVELOPMENT OF ON-LINE ACCESS TO INFORMATION AT THE NATIONAL LEVEL

1st Stage	2nd Stage	3rd Stage
Beginning of national bibliographic databases. Demonstrations and pilot on-line access to external sources. Study of needs for computerized access to factual data.	Establishment of national host(s) providing on-line access to several national databases and some external databases. Batch treatment in the country of priority external databases	Most national bibliographic data, essential national factual data and some priority external data accessible on-line from national host(s). External host(s) regularly accessed on-line.

In the first stage, which is well underway in Indonesia, a country works to satisfy its basic information needs by establishing an effective national information network of libraries, documentation centres, archives and manual data services such as statistical publications. Bibliographic information is an invaluable resource for identifying required documents at home or abroad, and manual bibliographic services based on nationally compiled catalogues and bibliographies, as well as subscriptions to traditional indexing and abstracting journals, will be an integral part of the national network. Computerized national bibliographic services will naturally become feasible as the size of manual services increases and as computer and telecommunications facilities become available. Similarly, on-line access to external bibliographic databases will become possible, initially for demonstrations and special priority requests, and later as a routine service.

Factual databases are more sophisticated from the viewpoint of construction and use, but their advantage is that they provide the client directly with the information he needs. Some hosts in Europe and North America already have factual databases, and the EEC has been actively promoting their development for several years. Many of these databases provide social and economic statistics which pertain mainly to the developed countries while others are scientific in character. The development of publicly accessible national factual databases will normally be undertaken only after detailed study of available data and user needs. Nevertheless this type of database should prove very useful for the developing countries, perhaps initially in applications such as socio-economic planning and entrepreneurial activities and then in other areas such as science and technology.

In the second step, one could consider that a country is ready to establish its own on-line host(s), to take charge of computerization of national bibliographic information and to process some external databases locally (perhaps in batch mode initially). This may entail the acquisition or development of some relevant software, training of staff and perhaps obtaining some external data bases on magnetic tape or diskettes. Other data can be obtained by users directly from foreign hosts through low cost external telecommunications. Concerning factual information, the implementation of a limited number of national databases in specific priority fields could perhaps be initiated, with the assistance of external specialists if necessary.

The third stage constitutes the normal progression from the previous two and marks wide acceptance and use in the country of national and external on-line information hosts.

A major problem in the organization and use of national databases is that normally the first years of operation will involve considerable net investment even if users are charged for services; the possibility of ultimately recuperating investments through user contributions needs to be considered from the point of view of overall information policy, operating expenses and market analysis. However, it can be seen from Chapter IV that nearly all the urgent needs for national databases in Indonesia concern information produced by public institutions (research institutes, specialized and university libraries, the Central Bureau of Statistics, etc.) for use, at least initially, by relatively small groups of public sector users. The development of these public sector applications should therefore be given a high initial priority within the overall national network strategy, perhaps by providing appropriate host computer resources and/or support for computerization to the sponsoring institutions.

It should be noted that third party computer use (private use for 'organizational' and administrative applications) is very important in the strategy for host development in Indonesia because of the revenues it will provide for the NPSN and for national computer facilities. Such third party data traffic can also of course play an important role in the economic development of a country, e.g., through more efficient accounting, more effective planning and inventory management,and better communication within and among administrations and enterprises. Because of the situation of low public awareness of on-line information services in Indonesia, host computers will probably develop publicly accessible data processing services before national databases providing specialized information become widely available. These applications can in turn generate revenues which could provide immediate profits for the host(s) as well as facilitating the establishment of the specialized databases needed for education, research and decision making. Typical targets for the distribution of revenues among the different users within such a strategy are illustrated below:

FIGURE 11: PROPOSED IMPORTANCE OF DIFFERENT DATA SERVICES IN THE BUDGET OF A TYPICAL MULTI-PURPOSE NATIONAL HOST

Activity	Clients	Percentage of revenues (second stage in figure 10)	Percentage of revenues (third stage in figure 10)
Specialized information services, e.g. scientific and technical information	Domestic clients	small	large
	External clients	very small	small
Third-party use (computer resource sharing)	Administrations and enterprises with specific computer needs	greatest	large

External databases from the developed countries or from international sources will usually contain information only in foreign languages. In Indonesia these sources might be chosen in the first instance to provide information in English since most Indonesian scientists, managers and students can read it fluently. National databases would normally be compiled in the national language unless external users are expected, and software applications could be written in such a way that both English and Bahasa Indonesia can be used for interrogation, according to the first command introduced by the user.

The choice of protocols* for data transmission and for communication of the users with the national host software is very important, since they form the backbone of the user links to the network. The command languages and the log-in procedure(s)* ought to be standardized insofar as possible and easy to master in order to attract the largest possible number of users.

5.8 Tele-informatics services

Present developments in telecommunications make possible a full range of tele-informatics services for the users (see section 2.5). In Indonesia, a list of urgent needs for such public services should be planned with the help of the telecommunications authorities. A very preliminary proposal for such a list is presented as figure 12. Most of these services could certainly be provided by the PALAPA satellite if the enhancements of PACKSATNET discussed earlier in this chapter are

* See glossary, Annex 8

FIGURE 12 : POTENTIAL USERS OF VARIOUS TELECOMMUNICATIONS SERVICES

USERS	Public telephone connections	Telex	Private telecommunications connect.	Facsimile	Tele-printing & remote data entry	Interactive VDU Terminal	Electronic mail	Tele-Charging	Tele/audio conferens	Tele-writing	Tele-alarm
LARGE ENTITIES											
Administrations	U	U	U	U	E	E	E		E	E/A	E/A
Large enterprises	U	U	U	U	E	E	E	E/A	E	E/A	E/A
Press Sector and Mass Communications	U	U	U	U	E	E	E				
PROFESSIONNAL USERS AND SMALL BUSINESS	U	E		E		E		E/A			
GENERAL PUBLIC											
Private Customers	E										A
Public facilities (e.g. post office or community centres)	U	U		E	E	E		E/A	A	A	
RESEARCH AND EDUCATION											
STI users	U			E	A	E					
Computer centres	U			A	E/A	A					
Education Centres	U	E		E		E/A			E/A	E/A	
LIBRARIES DOCUMENTATION CENTRES AND ARCHIVES	U	U		U	E	E					

E : Essential user service in the future

A : Additionnal user service which may be requested

U : Urgent user service

implemented. The NPSN could thus allow low cost internode telex traffic and facsimile connections, as well as data services such as teletex and videotex. Implementation of the latter services could be considered as a means of making standard data terminals for interactive use and remote printing widely available at low cost, as well as serving the essentially commercial uses of teletex and videotex which are foreseen in the developed countries.

5.9 Investments

The financial aspects of the National Packet Switching Network need to be treated by specialists in finance and in telecommunications. Solutions should be sought which avoid a heavy deficit in the first years of high investment, and thereafter a strategy which ensures an appropriate balance in the national telecommunications budget has to be pursued. Telecommunications investments generally originate from the Government and from profits accruing from operations. When a data network first starts, it is quite difficult to make a profit, and if Government does not, or cannot,consider data telecommunications as a priority sector at that time, the investment is likely to be insufficient.

One solution which has been used in developed countries and some developing countries consists in opening a special bank called, for example, the 'telecommunications investment fund'. Such a state-owned bank would issue bonds regularly, each bond being reimbursed with interest after five or ten years. National and foreign citizens, private companies and state-owned enterprises could be approached to buy such bonds, not only as an investment but also to participate in progress of the national economy. As an additional guarantee to the investors, the 'telecommunications investment fund' might be designated as the owner of the new telecommunications hardware for a period of five or perhaps ten years. The telecommunication administration could then obtain its hardware from the investment fund through a lease/purchase arrangement*. After five years of major effort towards the creation of a public data network, it can be expected that the overall investment should provide good revenues within the telecommunications budget as well as supporting national social and economic development.

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* Lease/purchase arrangements are operations concerning the leasing of capital equipment, tools or business real estate especially bought for that purpose by enterprises which retain their right of property, when these operations give the leasee the possibility of buying part or the totality of the goods on payment of a stated sum, taking into account, at least partly, the instalments already paid as rent (Definition provided in a French law of 2 July 1966).

VI. International strategy options

6.1 A regional packet switching network

The question of sharing the resources of the National Packet Switching Network with neighbouring countries is of great potential importance. Databases or network services in a country such as Indonesia may well arouse the interest of foreign users, and Indonesian users will require on-line access to information sources in the region. It will also be convenient for the viewpoint of network revenues to accomodate incoming or outgoing traffic if there is any opportunity. It is clear that interconnection of the ASEAN countries may be a priority concern, due to the present political context and their proximity. These countries are thus often cited explicitly in the present chapter, but the same principles would apply to networks involving other developing countries. It should also be emphasized that the various technical options are presented in this chapter in simplified form for the benefit of readers who are not telecommunications specialists.

One of the simplist ways to interconnect the five ASEAN countries (Indonesia, Malaysia, Philippines, Singapore and Thailand) in the same data network would consist in implementing links among all the users through local earth stations which would together employ a single transponder* of the PALAPA satellite. This solution could be considered as a first step of enhancement before a truly regional network could be organized or as a helpful solution for the connection of certain priority users in the four other countries to the Indonesian network.

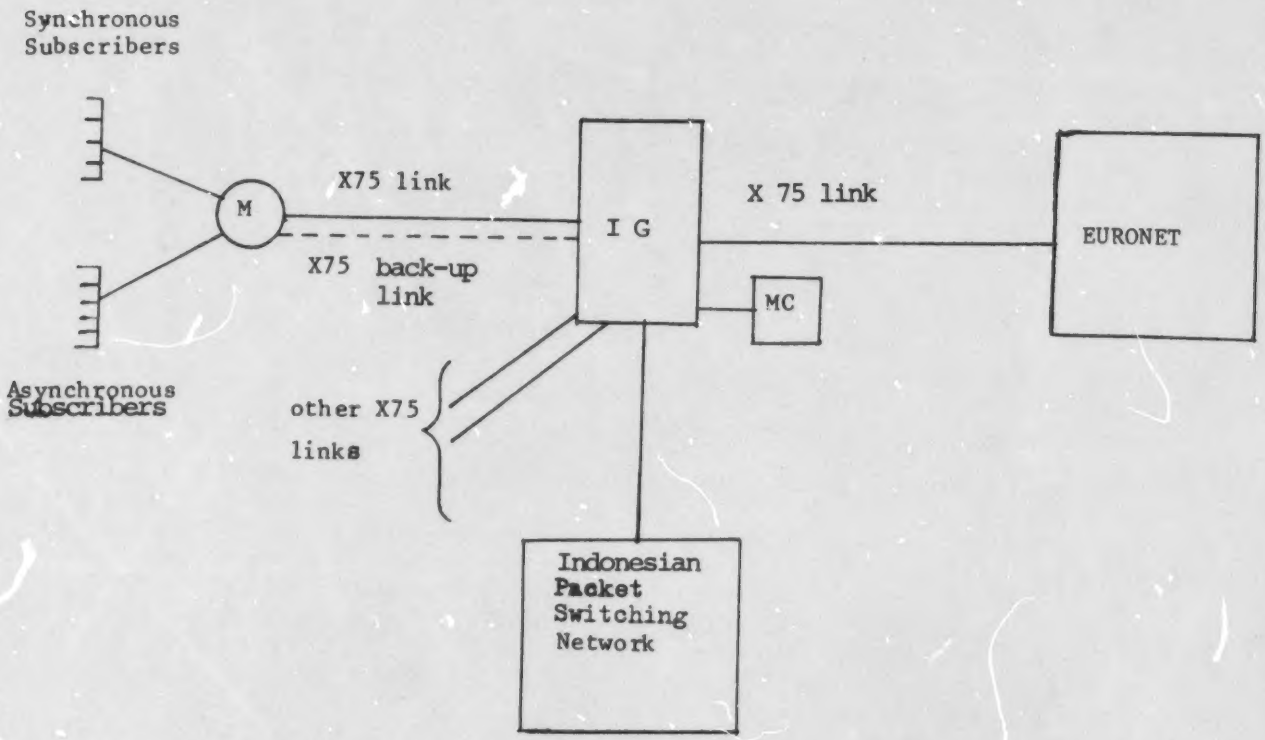
It should be noted that Intelsat negotiations need to be pursued whenever regular international traffic is envisaged on a domestic satellite channel. Temporary arrangements could probably be reached easily, particularly for a relatively small number of connections. This sort of approach would allow more flexibility in the later development of the regional packet network.

Another solution for linking the four other ASEAN countries to the Indonesian NPSN (and already employed in Europe for connecting external users to EURONET) is to use a multiplexer in each remote country, connected by a backed-up X75* link to an international gateway which is in turn linked to a node of the main network (see figure 13). In this solution billing and supervision of the remote customers are performed in the management centre of the main network (in this case the NPSN of one country) rather than by the administrations of the remotely connected countries. The most advanced trend is now to use a concentrator instead of a multiplexer (see section 5.4). Although the operational aspects are identical in both cases, the concentrator allocates more users on the same junction than the multiplexer, thanks to the use of dynamic allocation, and thus presents a less expensive solution than the fixed subscriber allocations of the multiplexer.

A third and longer term solution would consist in allocating a specific satellite transponder for each ASEAN country (or for each group of two or three countries). The actual network design, involving a regional mesh network* to be connected to national public data networks where they exist, would depend on the techniques choosen by the individual countries to satisfy their own domestic packet switching needs. A regional mesh network, like a national data network, can make use of any good telecommunication links. Generally speaking such links are already

* See glossary, Chapter IX

FIGURE 13 : CONNECTION FROM AN INTERNATIONAL GATEWAY TO A REMOTE COUNTRY USING A MULTIPLER/CONCENTRATOR



M Multiplexer
/Concentrator in the remote country
MC Management Centre
IG International Gateway

available and are not too expensive if they are effectively used. Traffic will be heavy on several circuits, and on these paths one should determine whether a new technical arrangement could enable better utilization of existing capacity to serve the different users at different bit rates. Some countries would perhaps prefer to use submarine cables instead of satellites for international connections for various reasons: best use of existing resources, technical simplicity, security of messages,etc. Annex 7 shows the cable connections which exist or are expected to be available by the early 1990's and which could therefore be considered for implementation of data network interconnections.

6.2 Links to countries outside the region

A regional packet switching network could also provide better international data links from the region to networks in the industrialized countries. One can imagine two different technical solutions. For the five ASEAN countries, there could be a single international gateway receiving all the extra-regional X75 links (from TYMNET, EURONET, etc.) and synchronous X25 connections to the switching nodes of the regional mesh network (see figure 14). The switching nodes in turn would each receive calls from leased line, dial-up and telex customers via packet assembler disassembler (PAD) equipment or from the national public data network of the country concerned, exactly as proposed earlier for the Indonesian NPSN.

Another configuration, or another step in evolution of international access, could consist in providing an international gateway for each country, thus avoiding the need to share the cost of a global accounting mechanism and of a common operational centre (see figure 15). The relevant costs of these alternatives could be evaluated from the basic equipment costs such as those given in section 5.4.

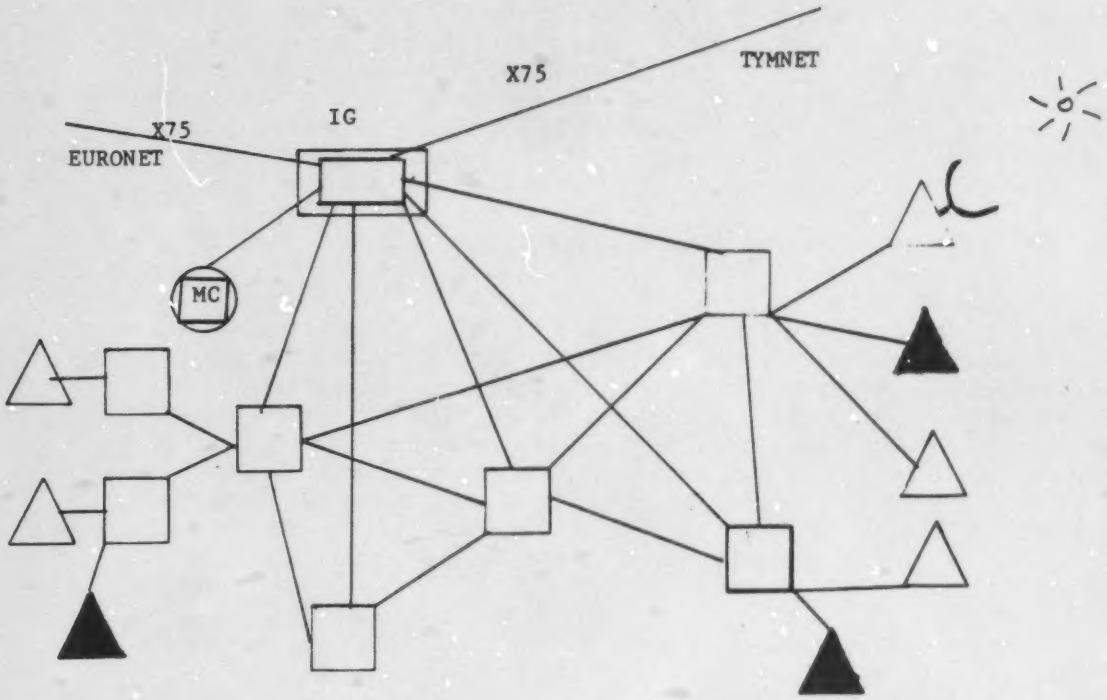
6.3 Shared databases and computer facilities

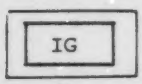
To avoid duplication of effort and unnecessary competition in development of databases and computer facilities, it seems appropriate to coordinate action in these fields among the countries of the region. Steps have already been taken to develop cooperative databases in certain areas as indicated in section 4.1.5.

In other fields, the possibility of regional cooperation is under consideration. For example, the Regional Mineral Resources Development Centre (RMRDC) in Bandung has been charged with establishing a 'regional mineral database'. In the Member States of the Economic and Social Commission for Asia and Pacific (ESCAP), 'there is a tacit demand for such a mineral database', but, as mentioned in the RMRDC Newsletter, September 1981, 'the kind of information that is possible to put into it, as well as the uses to which this is to be put, are questions that still have to be posed and properly answered'.

Thus the concept of shared databases among Asian countries or among countries of the East and South-East Asia region has been accepted by many parties, but some problems remain to be solved concerning the coverage of new databases to be set up and shared (oceanography, energy, mineral resources, socio-economic statistics, etc.) and the institutional framework and technical facilities for their establishment. Another major aspect on which agreement is needed is that of standard transmission and

FIGURE 14 : SUGGESTED INTER-REGIONAL CONNECTIONS USING ONLY ONE INTERNATIONAL GATEWAY IN SOUTH EAST ASIA





International Gateway (16 switching node ports with special software) (IG)

Management Centre (billing, statistics, operation...)

Packet Switching Node (8 ports X 25/X75)

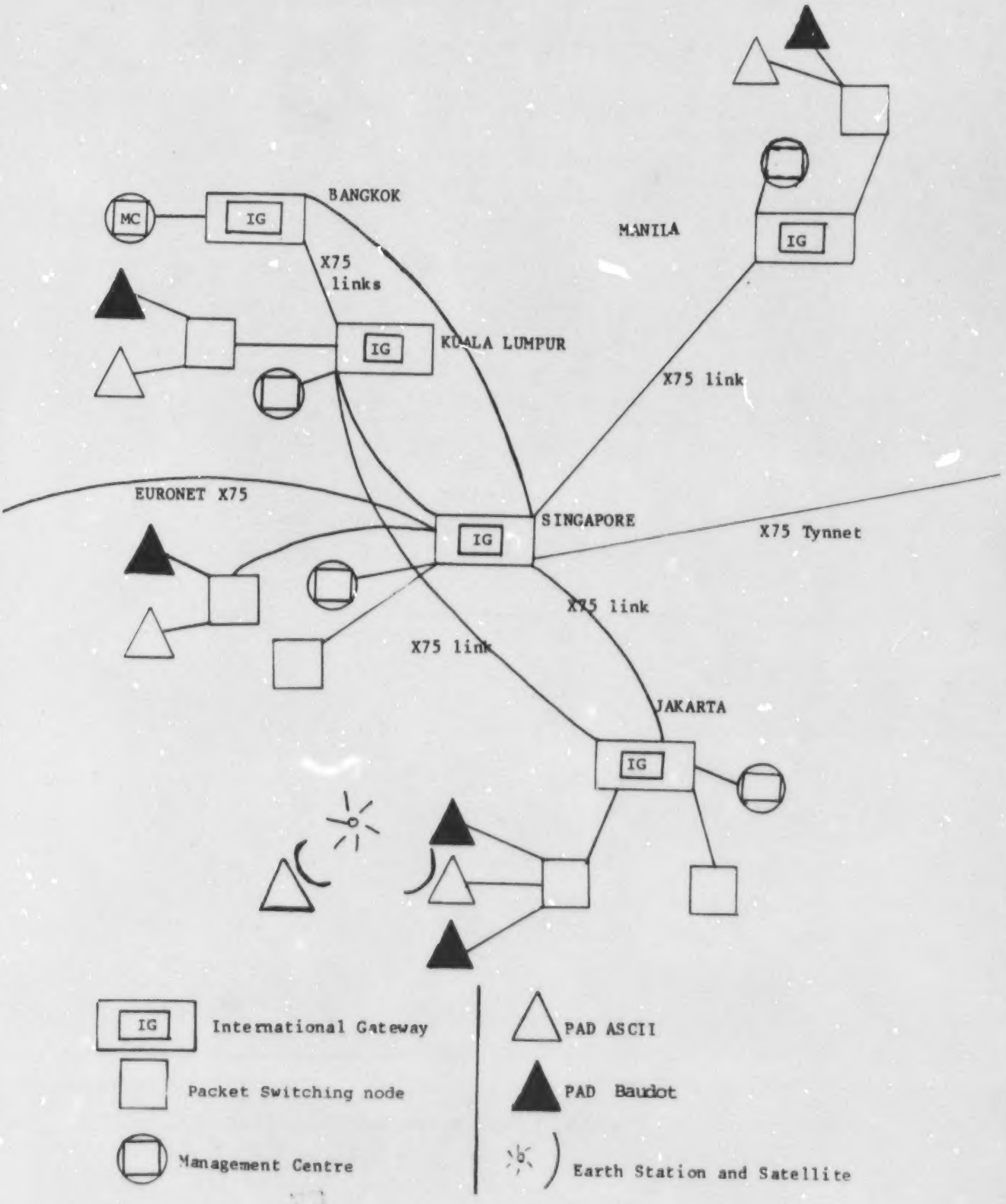
Packet Assembler Disassembler (PAD) (7 or 15 asynchronous incoming X3, X28/X29 accesses (ASCII), one outgoing X25 access)

PAD (7 or 15 Baudot accesses, one outgoing X25 access)

PACKSATNET Earth Station

PALAPA Satellite

FIGURE 15 : SUGGESTED INTER-REGIONAL NETWORK USING AN INTERNATIONAL GATEWAY FOR EACH ASEAN COUNTRY



user protocols in the region. These important questions should be considered as soon as possible by the concerned Member States. A necessary first step would involve the creation of a permanent regional inventory of planned and existing databases and data transmission projects.

It is obvious that shared databases and computer facilities must employ a limited number of, or preferably a single, commonly understood language, as well as a system of commands and procedures which is easy to use and permits access via simple, cheap terminals. As previously mentioned, the videotex standard of CEPT (the European Conference of Post and Telecommunications Administrations) appears to be an example of a relevant terminal for the ordinary users,since it is very inexpensive and its software can be easily updated to handle any character sets or patterns.

6.4 DEVNET

The plans for this information network among developing countries were described in section 4.1.5. It does not seem reasonable to set up a special international network, separate from the other telecommunications links, for a project like DEVNET. The more international data traffic that one can group in the same bundle (see section 5.4), the more advantages will accrue to the administrations and to the users. At the Indonesian level, existing services such as the press bulletin network or the experimental electronic mail facility could provide a technical basis for national participation.

6.5 Regional Network for Scientific and Technological Information in East and South-East Asia

The preceding sections have covered several technical aspects pertaining to a future operational network for the ASEAN countries or a wider grouping of Member States. In summary, the development of such a network would require:

- the implementation of a regional data network
- the setting up of external connections
- the establishment of shared databases
- the formulation of an agreement on budgetary matters such as
  - . investment costs
  - . operating costs
  - . maintenance costs
  - . line costs
  - . tariff aspects
  - . an accounting system among the concerned countries.

History shows that neighbouring countries, in spite of their proximity, have different views, different customs as well as different targets and speeds of development. Such differences between countries can lead to specific problems which may be difficult to resolve. It is thus possible that no international or regional organization would be in position to assume the responsibility for coordination of the required network, in which case the best solution for network development would be bilateral negotiations. This sort of pragmatic approach might in fact give the best chances of success since there would not be any leadership or supranationality issues concerning responsibility for the project. Cooperation with existing networks could be very helpful for the countries of East and South-East Asia.One possibility which should be investigated is that of obtaining special help for an emerging regional data network in the form of subsidized or free access to databases of established networks or hosts in the developed countries. The possibility of technical assistance should also be explored.

The example of EURONET, with which one of the present authors is associated, comes to mind as a model, but EURONET is, in fact, essentially only a short-lived network. It has now received its last level of technical enhancement (through the implementation of the X3, X25, X28, X29, X75 and X121* CCITT recommendations), and many of the European countries concerned are preparing to by-pass EURONET with external and bilateral X75 links as soon as they establish their national packet networks and their own international gateway. EURONET will probably be terminated by the end of 1984, and the European Economic Community may leave the project even earlier. It is recognized, however, that this 'supranational' approach has been successful since EURONET has been fully implemented, and since all the ten countries will have their national data networks very soon. One conclusion is probably that an international organization can be helpful for <u>starting</u> a regional project with the full agreement of the concerned countries.

* See glossary, Annex 8

VII. Conclusions and Recommendations

Sections 7.1 and 7.2 cover general considerations in improving the transfer of information and data for development while the remaining sections of this chapter present a check list of technical recommendations bearing on the establishment of a national public data network and its associated services in developing countries. Although the conclusions and recommendations take account of the particular situation in Indonesia and South-East Asia, they should not be seen as applying only to a particular country or region unless explicitly specified.

7.1. National policy

7.1.1. The national authorities need to consider the telecommunications network as a keystone of economic development.

Both basic telecommunications services and specialized data communication services should be accorded priority, in such a way that they develop in a complementary manner and at a pace reflecting their relative importance in achieving national goals.

7.1.2. Within the area of data communication, it is important to give a high priority to the transfer of scientific and technical information for research, development and decision making,

starting with information exchange among information centres (e.g., libraries, documentation centres and data repositories) and institutional users (e.g., research institutes, universities and government administrations) in the public sector. This approach can be seen as an investment in knowledge which will lead to more effective and more rapid national development and also as the first step within a long term plan to provide public information services to the overall business and professional communities and eventually to the general public.

7.1.3. In order to effectively promote the transfer of information required in Indonesia it appears necessary to move quickly from the experimental network level towards the establishment of a National Packet Switching Network (NPSN),

making full use of the present and potential facilities of the Indonesian telecommunications network. In the short term, the data network should attract a maximum number of users and should provide connections to external public data networks. A possible schedule of action is presented schematically in figure 16.

7.1.4. In planning and developing a National Packet Switching Network, it is necessary to pursue an appropriate coordination of all the concerned national entities,

i.e., those with responsibilities in the fields of information telecommunications, computerization and planning, and to work in close collaboration which the major user interests.

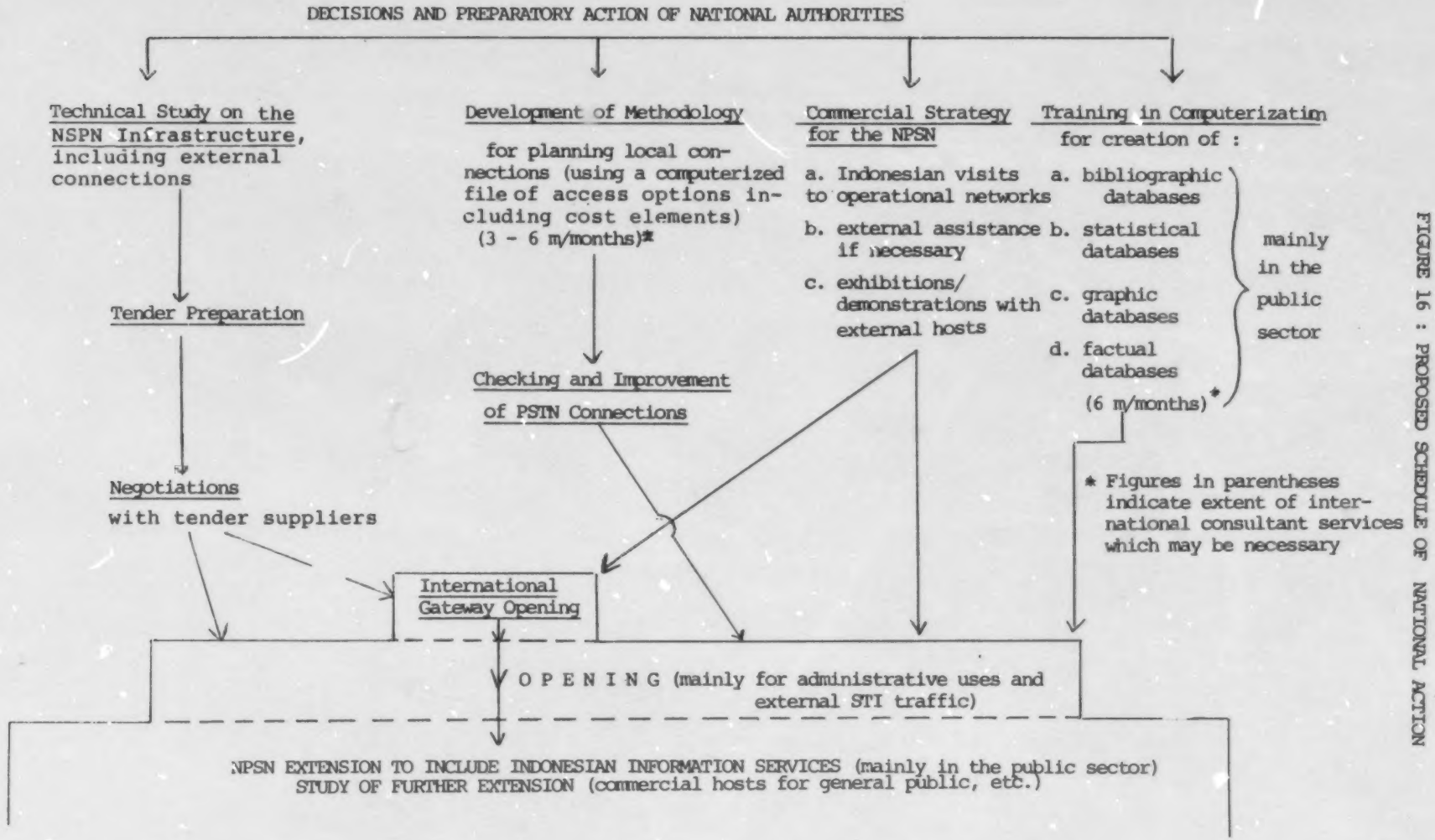

DECISIONS AND PREPARATORY ACTION OF NATIONAL AUTHORITIES
Technical Study on the NSPN Infrastructure, including external connections
Development of Methodology
for planning local connections (using a computerized file of access options including cost elements)
(3 - 6 m/months)*
Commercial Strategy for the NPSN
a. Indonesian visits to operational networks
b. external assistance if necessary
c. exhibitions/ demonstrations with external hosts
Training in Computerizatim for creation of :
a. bibliographic databases
b. statistical databases
c. graphic databases
d. factual databases
(6 m/months)*
mainly in the public sector
Tender Preparation
Checking and Improvement of PSTN Connections
Negotiations with tender suppliers
* Figures in parentheses indicate extent of international consultant services which may be necessary
International Gateway Opening
O P E N I N G (mainly for administrative uses and external STI traffic)
NPSN EXTENSION TO INCLUDE INDONESIAN INFORMATION SERVICES (mainly in the public sector)
STUDY OF FURTHER EXTENSION (commercial hosts for general public, etc.)

FIGURE 16 : PROPOSED SCHEDULE OF NATIONAL ACTION

7.1.5. The development of useful national scientific, technological and socio-economic databases, and the improvement of access to them, should be encouraged by the national authorities.

for this purpose one could ensure:

a. the establishment of a comprehensive referral file to national sources of information, including both computerized and traditional information services;

b. provision of advice and technical assistance to agencies wishing to establish computerized information services. Adequate remote computer facilities should be available for such activities when purchase of an in-house computer is not justified, and the establishment of a principal national host for publicly accessible databases might be considered at an appropriate time;

c. the establishment of an electronic telephone directory as a database for operators as well as a technical data file on existing and required PSTN connections for data communication;

d. the provision of tele-informatics services and appropriate terminal for easy access to database via the NPSN (see point 7.3.7).

7.1.6. The National Packet Switching Network and its standard services should be developed in a way which would facilitate the future offering of videotex or teletex services

to the general Indonesian public, particularly in the rural areas, subject to completion of a study on the feasibility and benefits of such services.

7.1.7. An international gateway for public data communication should be opened as soon as possible.

The National Packet Switching Network should ultimately provide gateways to databases located abroad as well as to national hosts (see section 5.4). In the meantime, in view of the urgent need for access to information in certain priority areas, the national authorities should facilitate pilot external linkages by:

a. organizing demonstrations of on-line information transfer from foreign databases and networks (also see point 7.3.2);

b. facilitating international leased line connections which enable a number of user institutions to share the costs of on-line access;

c. preparation of contracts for the early establishment of an international gateway to handle the external data connections of a limited number of priority users;

d. Careful monitoring of international data traffic in view to improving future access.

7.2. Regional and international cooperation

7.2.1. A visit of national telecommunications specialists to study the experience of existing networks, particularly in the areas of organization and marketing, could be helpful in orienting the data network study and could clarify the possibilities for further international contacts or cooperation.

For example, a visit could be undertaken to General Directorate XIII of the Commission of the European Economic Communities (the EURONET Launch team and the Committee on Scientific and Technical Information and Documentation) to gain experience in preparing the strategy for a data network and in the promotion of database development.

7.2.2. Bilateral and international (particularly ITU) cooperation could be sought on extension and management of the NPSN, in close coordination with national objectives and action.

Appropriate bilateral and/or ITU assistance should be negociated in order to develop the data network itself while Unesco could be approached on problems of database development. Close contacts should be established with the CCDEVTEL programme of ITU in the fields of specialized training and telecommunications documentation.

7.2.3. Multilateral contacts should be pursued in view to reducing long line costs and to ensuring an optimum utilization of the long lines.

Such contacts should include:

- negotiations with Intelsat on arrangements for international satellite data communication, and

- bilateral negotiations to reach agreement on optimal line cost partitioning and on the technical aspects of line sharing.

Prior to these contacts a study should be made on options for sharing external connections among different services and users, and the relevant costs should be compared.

7.2.4. The ASEAN countries and other interested Member States should study the best first steps to be taken in developing a regional data network through the sharing of tele-informatics resources and databases.

Different steps of enhancement of a regional packet network could be considered along with the implementation of a single or several international gateways. The cooperating countries should begin to decide on the coverage of future common databases and on necessary standards for establishing and accessing them.

In developing the national networks in Asia close attention should be paid to relevant experience in other countries, particularly in the South-East Asian region where posibilities for systems interconnection or cooperative production of databases may exist. It should be noted that several sectoral information programmes are already developing in the region (e.g., in agricultural, industrial, mineral resources and telecommunications information) and that a project for a Regional

Scientific and Technological Information Network for the Exchange of Information and Experience in Science and Technology in Asia and the Pacific (ASTINFO) has been prepared with Unesco assistance and submitted for international financing.

7.3. Marketing and tariff strategy/user awareness

7.3.1. Given the constraints of most national telecommunications administrations, a marketing and commercial approach is necessary to raise the interest of potential customers, to avoid a deficit and to increase each year the revenue from the network.

In this context it is necessary to bear in mind the problems of the telecommunications system as seen by the customer. The volume of traffic must also be considered in detail in terms of both paths and time dependence. 'Commercial telecommunication offices' are a good way to provide customer information and to obtain feedback on trends in the market for new services.

7.3.2. Decisions and action on establishing the NPSN would be greatly facilitated if an international exhibition were held in Indonesia during several weeks, to promote, in each field of public and private activity, an awareness of the capabilities of new data communication services developed in other countries.

The aim would be to raise interest and awareness about existing databases, terminals and telecommunications services. A demonstration of access to databases in Europe or North America related to the field of interest of the persons attending the exhibition could be included.

7.3.3. Optimization of use is the key to ensuring success of a data network. For this reason, it is recommended that the network handle 'organizational' traffic (commercial and administrative flows of information) at the same time as scientific and technical information.

In this way the total operational costs would partially be paid by administrative and commercial users, who would in turn receive better and cheaper services than presently obtained through leased lines or telex.

7.3.4. Special commercial campaigns need to be launched for each new national service or database.

It will be convenient to plan each campaign in relation to the specific groups of potential users to be reached: researchers, engineers, accounting staff, lawyers, specialists in marketing, banking and insurance executives, etc. A special budget for advertizing in the specialized press has to be foreseen. The potential users need to be advised on the new data services and on the relevant future tariffs two years in advance of the opening of the network. Demonstrations of the use of some model databases and special services should be performed at least six months before the opening of the NPSN. Leased lines should be employed in all these local exhibitions if there is any doubt about line quality at that time. Professional and other user-oriented meetings during the promotional

campaign should provide an opportunity to accustom the participants to the use of the new data services.

7.3.5. The NPSN tariff policy needs to conform, in so far as possible, to CCITT recommendations and to general bilateral/international agreements.

The analytic method of the Asia-Pacific Telecommunity tariff study (16) could be applied, taking account of the following points:

- the tariffs for possible telex traffic on the NPSN should be less or at most equal to those on the present telex network;

- depending upon geographical considerations, local traffic between certain islands might make use of international traffic units;

- the distance factor should have little or no effect on the cost to users to the NPSN facility (satellite use is one of the reasons);

- the charges to data network customers have to be very attractive during the first years of network operation in order to increase traffic quickly and ensure the fastest possible recuperation of investments;

- the charges for domestic leased circuits have to be increased in order to attract traffic into the NPSN;

- a reduction for bulk traffic would encourage the use of data network instead of leased lines;

- the inclusion of free calls in the subscription fee for the data network (e.g., for enquiry services or for 'echo service') should to be introduced with prudence because the repetitive usage of these free calls is able to perturb or congest the network.

7.3.6. The possibility of adopting special tariffs for certain public sector data users, perhaps limited to periods of low overall data traffic, should be seriously considered.

7.3.7. In order to stimulate development and use of the NPSN the administration should standardize the characteristics of the basic tele-informatics services to be available through the network, and should take steps to ensure that appropriate user terminals are made available at acceptable prices, perhaps through local manufacturers.

These services should include:

a. teleprinting, remote data entry and electronic mail (perhaps to be incorporated into a single teletex service);

b. visual display based information retrieval (perhaps to be incorporated into a videotex service);

c. Facsimile transmission.

7.3.8. User feedback concerning the network and its services could be promoted through the establishment of user groups at two levels:

a. a general telecommunications user group to advise on the quality and characteristics of the network and its standardized services;

b. sectoral groups, as appropriate, to consult on the need for improvements in databases and host services in specific areas.

Members of these user groups could receive a periodic letter giving them information about achievements in telecommunications development, expected improvements in the network and a schedule of planned exhibitions and demonstrations of new services in the country. These user groups would provide very good support for information exchange between the network administration and the users.

7.4. Investments

Detailed study of the overall investment and operational costs of the future NPSN should be undertaken (including the specific areas of study foreseen in sections 7.3, 7.5 and 7.6), and all possible options (see, for example, section 5.9) for financing the network should be carefully weighed.

In particular, it will be necessary to compare the various technical choices in order to minimize:

- the total initial national investment;

- the unit cost, and the number, of spare parts needed for maintenance of the network;

and to maximize:

- the effectiveness of the links and transmission channels;

- the capacity of the overall network as seen by the users.

The operating costs of the overall network need to be reduced, particularly with regard to personnel. It is therefore particularly important to provide an estimate of:

- the number of new staff necessary in each area of telecommunications and in each operational region of the network;

- the cost of necessary training of these specialized staff.

7.5 Human resources

7.5.1. A coherent system of staff training and refresher courses in data communication must be organized by competent teachers. The importance of the technicians must not be forgotten.

The training of trainers is the key to success in establishing a data network; it is not possible to devote too much care to this critical body of personnel.

The recycling of technical staff must be pursued periodically. Specialized refresher courses should be sandwiched between periods of appropriate field work.

7.5.2. The effect of the new NPSN on the existing telecommunication staffing structure should be carefully taken into account. Examples of possible useful measures are:

- participation of the staff in discussions leading to the adoption of the plan for the NPSN;

- ensuring adequate supervisory and decision-making responsibility within the NPSN organization;

- endeavouring to interest each level of staff in the improvement of the quality of data services as seen by the customer.

7.6. Standards/local manufacture of equipment

7.6.1. No more than the necessary number of CCITT transmission and terminal standards should be used in the network.

Although all the equipment should comply with CCITT requirements, there is no need to authorize the use of all categories of terminals or services mentioned in the CCITT list. Some of these terminals are authorized for historical reasons only or have been created because of temporary cost factors prevaling in Europe. A reduction of the number of standards employed will lead to a higher production of each sort of approved terminal and will simplify the software recuirements of the network. The choice of these standards needs to be studied in relation to local needs and the capability of the existing switched telephone network.

7.6.2. A rapid development of the data network will almost certainly require the acquisition of equipment produced outside of the country concerned.

The initial equipment which has to be sought abroad should be accuired on the basis of an international tender stipulating requirements for assistance in local maintenance and training.

7.6.3. The national industry should manufacture certain network equipment.

Some equipment could be built in a country at the level of development of Indonesia. Generally speaking all equipment which is relatively easy to design and which is required in large numbers in the short term should be considered, for example, transmission equipment, parts of the switching centres or parts of data terminals. This first step would help gain expertise needed for further development of the tele-informatics industry. One solution would be to buy a telecommunications equipment plant under a 'turn-key' arrangement. Help from UNIDO (the United Nations Industrial Development Organization) in Vienna could be asked in the area of equipment manufacture.

7.7 Research and development

7.7.1. In view to a future national Integrated Services Digital Network (ISDN) providing for long-range improvements and extensions of both the NPSN and basic telecommunications services, the Indonesian authorities should consider implementing a major programme for research, development and technology acquisition in the area of fibre optics, with emphasis on submarine cables.

The NPSN discussed in the present report is at an intermediate level between a traditional telecommunications network and the future Integrated Services Digital Network. It is expected that the ISDN will ultimately make intensive use of fibre optics cables within the rural areas. It would therefore be useful for the Indonesian telecommunications administration to start to study fibre optics techniques in such a way that it will be prepared to launch its own industry within the ten coming years. A first step would be, for example, to study the feasibility of manufacturing submarine cable using fibre optic techniques, perhaps in association with a foreign entity with experience in this technology.

With its nearly 14,000 islands, Indonesia undoubtedly has a lot of underwater connections to implement which are less than 40km long, that is to say, on paths which do not require amplifiers. Such connections would avoid the use of new satellite channels and would reduce frequency space occupancy. Furthermore, some submarine cables laid around islands could provide cheaper connections to neighbouring towns located near the sea.

7.7.2. The problem of accessing remote areas by telecommunications needs to be solved by original solutions found by research and development activities adapted to local needs.

Such solutions might include:

- temporary small telecommunications extensions using mobile units;

- unmanned telecommunication stations powered by wind or solar cell devices;

- broadcast videotex with encryption for the usage of large national entities wishing to provide their agents throughout the country with confidential information from a database maintained through NPSN services. Such a system could also be employed for closed user group TV transmission outside the hours of national TV programming.

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ANNEX 1 : SCHEDULE OF MEETINGS AND LIST OF PARTICIPANTS IN THE STUDY

Monday, 25 January 1982

1. Unesco Regional Office for Science and Technology for Southeast Asia

Mr. V. Prakash, Director
Mr. J.P. Herakovich, Administrative and Programme Officer
Mr. T. Kuroda, Specialist in Scientific Information

Tuesday, 26 January 1982 (accompanied by Mr. Ashari, Indonesian National Commission for Unesco)

1. Centre for Library Development, Ministry of Education and Culture

Ms. Ima Maskan, officer responsible for manpower development projects
Mr. John Rompas, officer responsible for public library development projects

2. National Library

Mrs. Mastini Hardjo Prakoso, Director

Wednesday, 27 January 1982

1. Planning meeting at the Ministry of Information

Drs. F. Rachmadi, Chief of R&D on Information Systems, Ministry of Information (Chairman)
Mr. Parman, Secretary, R&D Board, Ministry of Information
Ir. Arnold Ph. Djiwatampu, Director, Telecommunications Convention and Legal Regulations, Directorate General of Posts and Telecommunications
Mr. Soepojo Padmodipoetro, Executive Chairman, Indonesian National Commission for Unesco
Mr. Soenardi, Assistant to the Executive Chairman, Indonesian National Commission for Unesco

2. Directorate General of Posts and Telecommunications, Ministry of Communications

Ir. Rollin, Deputy Director-General for PTT
Ir. Dh. Suriawan, Deputy Director-General for Telecommunication
Ir. S. Bratahalim, Director, Engineering
Ir. Arnold Ph. Djiwatampu, Director, Telecommunications Convention and Legal Regulations
Ir. Sumitro Roestam , Coordinator of the Team of Experts/ Deputy Director for Planning and Engineering, INDOSAT

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Thursday, 28 January 1982 (accompanied by the staff of PERUMTEL)

1. PERUMTEL

Ir. S. Gunawan, Deputy Director of Planning
Ir. A.C. Simatupang, Switching Planning Division
Ir. Iman Sudiharto, Sub-Directorate of Planning
Ir. Hernawan Suhardjo, Sub-Directorate of Planning
Ir. T. Tearalangi, Test and Development Sub-Centre

2. National Electronics and Electrical Research Institute, Indonesian Institute of Sciences (LEN-LIPI)

Ir. Februanus, Secretary
Ir. Rustini Soemaryato Kayatmo, Head, Research Centre for Circuitry and Instrumentation
Ir. Dodi Hidayat Rivai, Training Centre on Energy Techniques

Friday, 29 January (accompanied by the staff of PERUMTEL)

1. Indonesian Telecommunications Industry Corporation (P.T.INTI)

Ir. Muchtil Junus, President-Director
Drs. Junirman Bahar, Commercial Manager
Mr. M. Dachlan, Assistant to the President-Director
Drs. Abdul Talib Rachman, Director of Administration and Finance
Mr. Tjaroso, Director, Radio Factory

2. Bandung Institute of Technology (I.T.B.)

Mr. Adjat Sakri, Librarian

Saturday, 30 January 1982

1. Telecommunication Training and Development Centre, PERUMTEL (Pusdiklitbangtel)

Mr. R. Ravarit, Project Manager, International Telecommunication Union
Mr. Sutanggar Tengker, Adviser to the Centre

2. Regional Mineral Resources Development Centre (RMRDC)

Mr. Djoko, Administrative officer
Dr. John Hepworth, Editor/Documentation/Information

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Monday, 1 February 1982 (accompanied by Mr. Parman, Ministry of Information)

1. Central Bureau of Statistics (B.P.S.)

Mr. P.L. Kasenda, Director, Bureau of Data Processing and Publication
Mr. Harsanto Sarwono, Head, Computer Operations and Control
Mr. Denny Syarifuddin, Head, Data Presentation Division

2. Bank of Indonesia

Mr. Soengkowo Prijoredjo, General Manager, Office of the Board
Mr. Muhyiddin Salleh, Deputy Manager, Office of the Board
Mr. R. Hardjo Santoso, Deputy Manager, Office of the Board
Mrs. Rustati Sumarlan, Deputy Chief, Office of the Board
Mr. Utomi, Assistant Manager, Office of the Board

3. ANTARA News Agency

Mr. August Marpaung Sh., General Manager/Editor-in-Chief
Mr. Mohamad Nahar, Deputy General Manager
Mr. R. Sukarman, Director, Technology and Telecommunication

Tuesday, 2 February (accompanied by Mr. Soenardi, Indonesian National Commission for Unesco)

1. PERTAMINA

Mr. Indra Kartasasmita, Director of Shipping and Telecommunications
Ir. Amri Lubis, Chief, Sub-Directorate of Telecommunications

2. Ministry of State for Research and Technology

Prof. M.T. Zen, Assistant Minister for Science and Technology

3. Garuda Indonesian Airways

Mr. R.A.J. Lumenta, Company Secretary and Director
Dra. E. Soedarmo, Manager of Special Projects

Wednesday, 3 February 1982 (accompanied by Ir. Sumartono Tjitrosidojo, Ministry of Information)

1. Ministry of Information
   Mr. Amiruddin, Chief, Telex System
   Mr. Dalimunthe, Chief, Library and Documentation Centre
   Mr. Dewabrata, Chief Engineer, T.V.R.I. Central Station
   Mr. Parman, Secretary, R&D Board
   Drs. F. Rachmadi, Chief of R&D on Information Services
   Mr. Ramli, Chief Editor, News Department, Radio Republik Indonesia
   Mr. B. Sembiring, Head, T.V.R.I. Training Centre
   Mr. Anwar Siregar, Manager, National Station, Radio Republik Indonesia
   Ir. Sumartono Tjitrosidojo, Chief of R&D on Information Technology

2. National Development Planning Agency (BAPPENAS)

   Mr. Darmawan Tas'an, officer responsible for telecommunications

3. National Scientific Documentation Centre (PDIN), Indonesian Institute of Sciences

   Miss Luwarsih Pringgoadisurjo, Director
   Miss Mimi D. Aman, Assistant Director for Library Matters
   Mrs. Utari, information dissemination specialist

Thursday, 4 February 1982

1. National Aeronautics and Space Institute (LAPAN)

   Ir. E. Jamin , Head, Division of Broadcasting and Space Communication/ Telfus Project Directorate
   Mr. Alit Bondan, telecommunications specialist
   Mr. Slamet Hadisaputro, telecommunications specialist
   Mr. Y . Rijono, telecommunications specialist
   Mr. Alfred Sitinjak, systems analysis specialist
   Mrs. Adrianti Triwiharto, telecommunications specialist

Friday, 5 February 1982 (accompanied by the staff of the Ministry of Information)

1. Faculty of Economics, University of Indonesia

   Mrs. Barmawi, Librarian

2. Indonesian National Secretariat for ASEAN, Ministry of Foreign Affairs

   Mr. Salim Abdullah, Social and Cultural Bureau
   Mr. R.Soewandi Kusumoadinoto, Economic Bureau
   Mr.Djoko Soejono, Head, Public Relations Division

Friday, 5 February 1982 (continued)

3. Unesco Regional Office for Science and Technology for Southeast Asia (ROST/SEA)

Mr. V. Prakash, Director
Mr. T. Kuroda, Specialist in Scientific Information

4. IN-SEARCH DATA Corporation

Mr. David Sparkes, Technical Adviser (administration)
Mr. Farquhar M. Stirling, Technical Adviser (research)

Saturday, 6 February 1982 (accompanied by Mr. Soenardi, Indonesian National Commission for Unesco)

1. Directorate General of Higher Education, Ministry of Education and Culture

Mr. Hamdan Mansur, officer responsible for university library development projects, Directorate of Academic Affairs

2. Concluding discussions at the Ministry of Information

Ir. Sumartono Tjitrosidojo, Chief of R&D on Information Technology, Ministry of Information (Chairman)
Miss Mimi D. Aman, Assistant Director for Library Matters, PDIN
Ir. Arnold Ph. Djiwatampu, Director, Telecommunications Convention and Legal Regulations, Directorate General of Posts and Telecommunications
Miss Luwarsih Pringgoadisurjo, Director, PDIN
Mr. T. Kuroda, Specialist in Scientific Information, ROST/SEA, Unesco
Ir. F.B. Moerwanto, Transmission Division, Directorate of Engineering, Directorate General of Posts and Telecommunications
Mr. Parman, Secretary, R&D Board, Ministry of Information
Mr. Raphael Rahardjo, Centre for Communication Technology for Education and Culture, Ministry of Education and Culture
Mr. Soenardi, Assistant to the Executive Chairman, Indonesian National Commission for Unesco

Tuesday, 2 March 1982 (discussions of Mr. D.P.Battu in London)

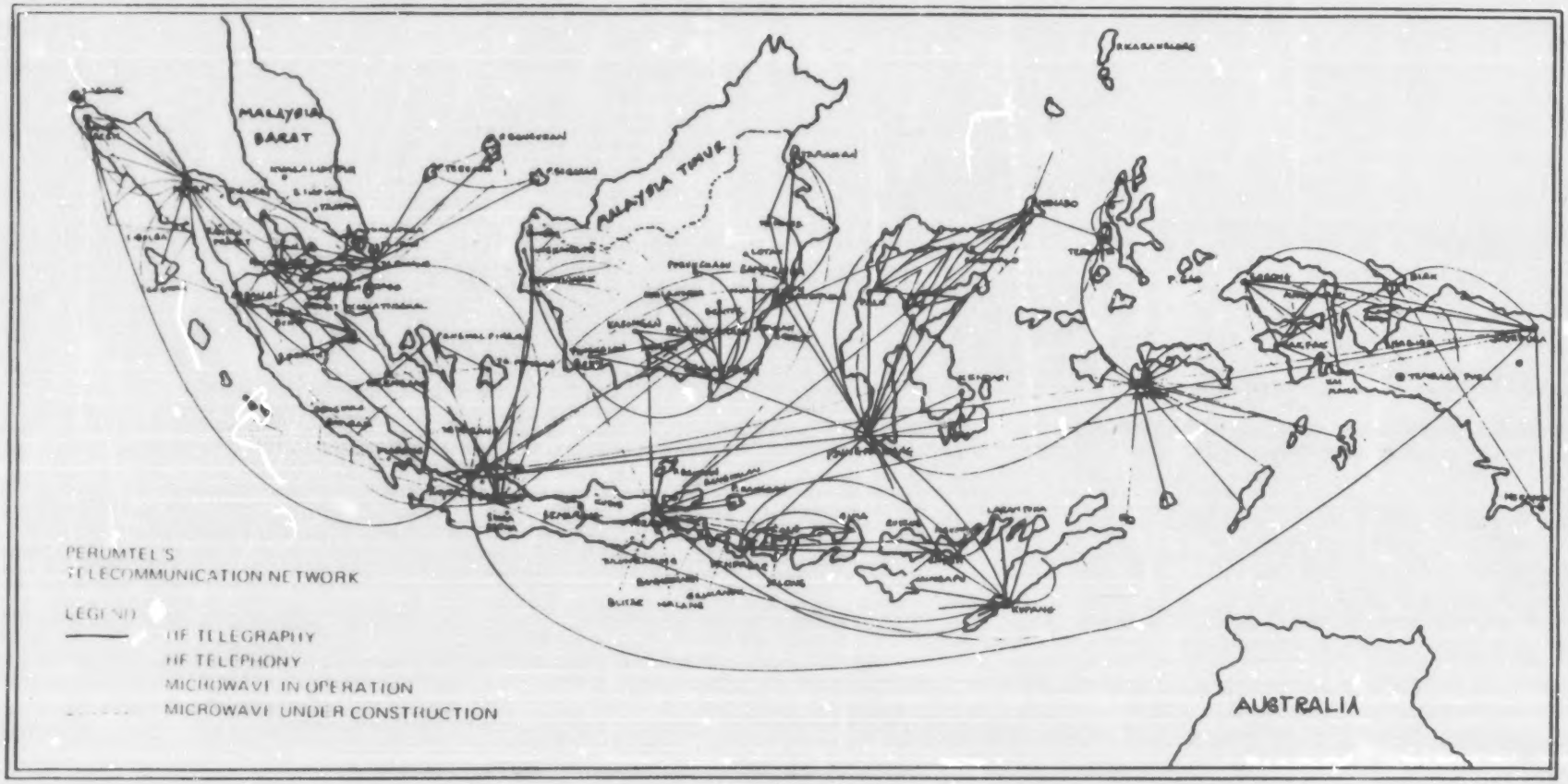
1. Logica, Ltd.

   Ir. R. Gozaly, P.T.INTI
   Mr. Andrew Karney, Business Manager,Communication Group
   Mr. Handy Loder
   Mr. Jeremie Tucker

2. University College, London

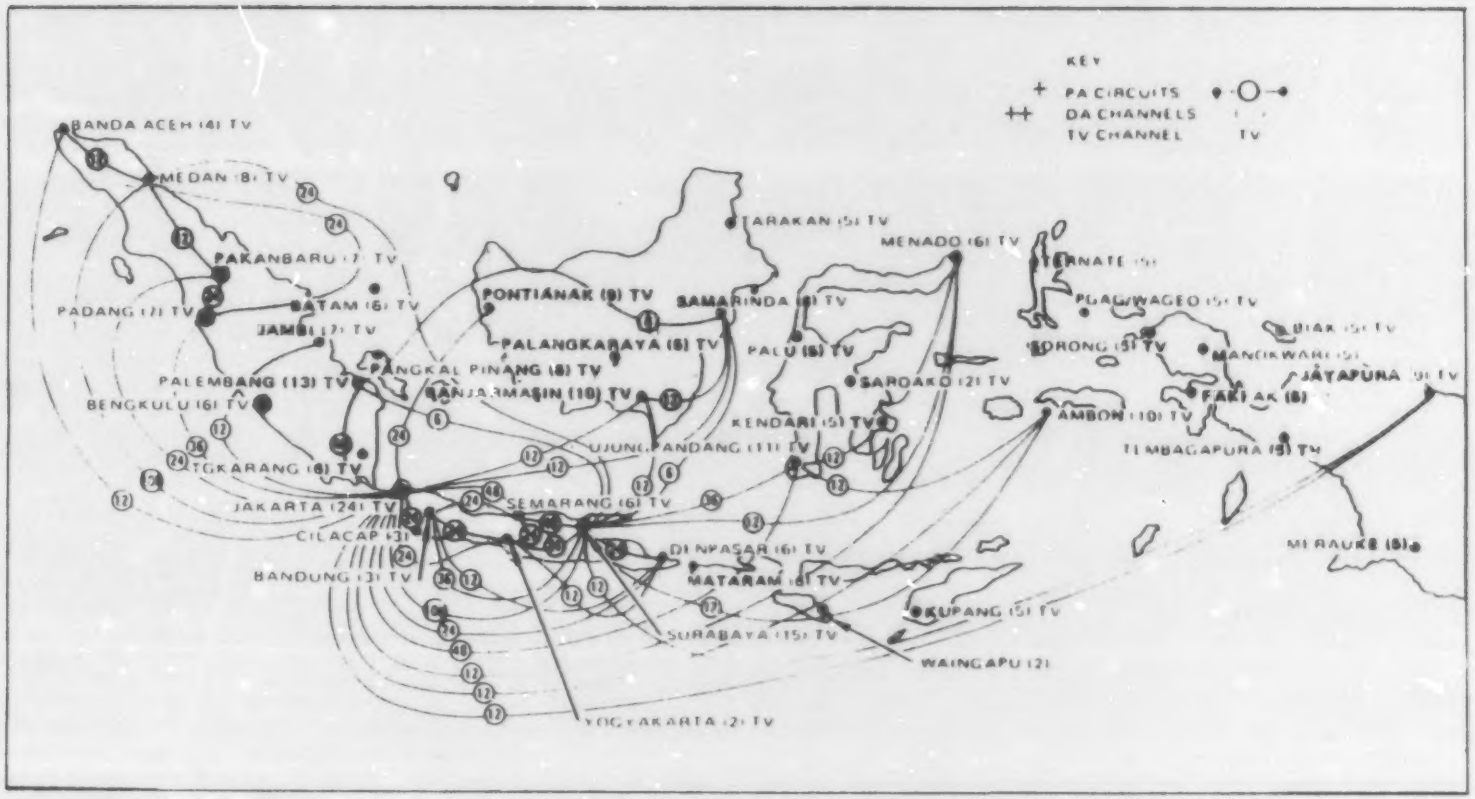
   Prof. Peter Kirstein

ANNEX 2 : PERUMTEL'S TELECOMMUNICATION NETWORK



Origin : PERUMTEL

Origin : PERUMTEL



+ Permanently assigned circuits
++ Demand assigned channels

ANNEX 4: PROGRESSIVE GROWTH OF THE INDONESIAN TELECOMMUNICATIONS NETWORK IN THE 1970'S

INDONÉSIE — INDONESIA — INDONESIA

Superficie/*Area*/Superficie = 1 904 345 km^2 — *Directorate General of Posts and Telecommunications - Jakarta*

Année se terminant le / Year ending on / Año terminado el 31.XII	Trafic/*Traffic*/Tráfico									
	I	II	III (1)	III (2)	IV (1)	IV (2)	IV (3)	V (1)	V (2)	VI
	Population *Population* Población	Ménages *Households* Familias	Conversations téléphoniques *Telephone calls* Comunicaciones telefónicas: Intérieur *National* Interior	Conversations téléphoniques *Telephone calls* Comunicaciones telefónicas: Internat. dép. *Outg. intern.* Intern. salida	Télégrammes taxés *Telegrams charged* Telegramas tasados: Intérieur *National* Interior	Télégrammes taxés *Telegrams charged* Telegramas tasados: Internationaux de départ *Outgoing international* Internacionales de salida: Plein tarif *Full rate* Plena tarifa	Télégrammes taxés *Telegrams charged* Telegramas tasados: Internationaux de départ *Outgoing international* Internacionales de salida: LT	Télex (minutes taxées) *Telex (minutes charged)* Télex (minutos tasados): Intérieur *National* Interior	Télex (minutes taxées) *Telex (minutes charged)* Télex (minutos tasados): Internat. dép. *Outg. intern.* Intern. salida	Phototélégr. internationaux de départ *Outgoing international phototelegrams* Telefotogramas internacionales de salida
	10^3	10^3	10^6	10^6	10^3	10^3	10^3	10^3	10^3	
1970	120 000	-	164	0,082	2 133	316	158	1 645	415	-
1971	123 000	-	192	0,143	2 389	306	154	2 262	648	-
1972	125 000	-	251	0,208	2 696	318	159	2 625	924	-
1973	126 000	-	256	0,288	3 459	369	185	3 308	1 401	-
1974	126 000	-	309	0,331	3 777	382	191	4 222	1 877	-
1975	132 000	-	875 1)	0,414	3 623	313	157	5 697	2 580	-
1976	135 000	-	1 149 1)	0,629	4 070	400	196	7 620	3 379	-
1977	138 000	-	1 556 1)	0,772	4 403	351	175	9 342	3 885	-
1978	-	-	-	-	-	-	-	-	-	-
1979	145 000	-	2 505 1)	1,094	5 503	268	97	14 426	5 508	-

Année se terminant le / Year ending on / Año terminado el 31.XII	Equipements/*Equipments*/Aparatos									
	VII (1)	VII (2)	VIII	IX (1)	IX (2)	X	XI	XII	XIII (1)	XIII (2)
	Postes téléphoniques/*Telephone stations*/Aparatos telefónicos							Télex / Telex	Modems	
	Principaux *Main* Principales	Principaux automatiques *Automatic main* Principales automáticos	Toute nature *All kinds* Todo tipo	p. 100 habit./*inhabit*: Principaux *Main* Principales	p. 100 habit./*inhabit*: Toute nature *All kinds* Todo tipo	Résidentiels *Residential* Residenciales	Liste attente *Waiting list* Lista espera	Lignes d'abonnement *Subscriber lines* Líneas de abonados	Réseau public *Public network* Red pública	Circ. loués *Leased circuits* Circ. arrendados
	10^3	10^3	10^3			10^3				
1970	143	71	201	0,12	0,17	-	-	628	-	-
1971	153	82	230	0,12	0,19	-	-	690	-	-
1972	165	94	260	0,13	0,19	-	-	807	-	-
1973	182	108	269	0,14	0,21	-	-	694	-	-
1974	193	113	285	0,15	0,23	-	-	1 109	-	-
1975	200	130	305	0,15	0,23	-	-	1 571	-	-
1976	220	138	319	0,16	0,23	-	-	1 942	-	-
1977	239	156	347	0,17	0,25	-	-	2 345	-	-
1978	-	-	-	-	-	-	-	-	-	-
1979	717	294	441	0,22	0,30	-	-	4 009	-	-

1) Nombre d'impulsions de taxation. — 1) Number of metered pulses. — 1) Número de impulsos de tasación.

Origin : Year Book of Common Carrier Telecommunications Statistics, 8th edition. Geneva, ITU.

ANNEX 5 : ANNUAL INVESTMENTS AND REVENUE OF THE INDONESIAN COMMON CARRIER TELECOMMUNICATION SERVICES IN THE 1970'S

INDONESIE — INDONESIA — INDONESIA

Monnaie nationale / *National currency* / Moneda nacional = Rupiah

Année se terminant le / *Year ending on* / Año terminado el 31.XII	XIV (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Recettes du service des télécommunications du secteur public (en monnaie nationale, à prix courants) / *Revenue of the common carrier telecommunication services (in national currency, at current prices)* / Ingresos del servicio de telecomunicaciones del sector público (en moneda nacional, a los precios corrientes)								
	Service téléphonique / *Telephone service* / Servicio telefónico					Service télégraphique / *Telegram service* / Servicio telegráfico	Service télex / *Telex service* / Servicio télex	Autres recettes / *Other revenue* / Otros ingresos	Total des recettes / *Total revenue* / Total de ingresos
	Frais de raccordement / *Connection charges* / Gastos de conexión	Redevances d'abonnement / *Annual rental* / Ingresos por abonos	Produit des communications / *From calls* / Productos de comunicaciones	Autres recettes / *Other revenue* / Otros ingresos	Total des recettes TF / *Total revenue of TF* / Total de ingresos TF				
	10^6	10^6	10^6	10^6	10^6	10^6	10^6	10^6	10^6
1970	913	3 304	2 220	939	7 381	1 477	416	276	9 550
1971	774	2 384	6 564	626	10 448	1 879	973	139	13 438
1972	1 181	3 185	9 352	526	14 243	2 243	1 399	266	18 112
1973	967	1 409	11 544	196	14 115	2 300	1 885	379	18 677
1974	815	1 637	18 391	167	21 008	2 936	2 981	211	27 135
1975	509	1 944	26 282	292	29 027	3 051	3 585	911	36 574
1976	-	-	-	-	42 698	4 600	4 054	581	51 933
1977	11 764	2 607	45 882	669	60 922	5 788	5 137	910	72 757
1978	-	-	-	-	-	-	-	-	-
1979	14 524	5 134	118 021	1 257	138 936	10 101	19 418	1 610	170 065

Année se terminant le / *Year ending on* / Año terminado el 31.XII	XV (1)	(2)	(3)	(4)	(5)	(6)	(7)	XVI	XVII
	Investissements bruts annuels des télécommunications du secteur public (en monnaie nationale, à prix courants) / *Annual gross investments of the common carrier telecommunication services (in national currency, at current prices)* / Inversiones brutas anuales para las telecomunicaciones del sector público (en moneda nacional, a los precios corrientes)							Frais pour entretien et réparations dans service TF / *Maintenance and repairs costs for TF service* / Gastos de mantenimiento y reparaciones en servicio TF	Taux de change à la fin de l'année / *Exchange rate at end of year* / Tipo de cambio al fin del año
	Du service téléphonique / *In telephone service* / Del servicio telefónico	Taux pour télécommunications / *Total for telecommunications* / Total para telecomunicaciones		P.I.B. au coût des facteurs / *G.D.P. at factor cost* / P.I.B. al coste de los factores	Ratio (3)/(4) / *Ratio (3)/(4)* / Relacion (3)/(4)	F.B.C.F. / *G.F.C.F.* / F.B.C.F.	Ratio (3)/(6) / *Ratio (3)/(6)* / Relacion (3)/(6)		
	Excluding	Excluding	Including						
	Terrains et bâtiments / *Land and buildings* / Terrenos y edificios								
	10^6	10^6	10^6	10^6	‰	10^6	‰	10^6	1 US $ =
									rupiahs
1970	489	1 136	1 327	-	-	-	-	-	392
1971	980	1 823	2 626	-	-	-	-	-	397
1972	1 301	4 346	4 555	-	-	-	-	-	417
1973	-	-	-	-	-	-	-	-	-
1974	-	-	-	-	-	-	-	-	-
1975	-	-	122 840	-	-	89 080	1 378	6 159	415
1976	-	-	-	-	-	-	-	11 127	415
1977	-	-	-	-	-	-	-	12 967	415
1978	-	-	-	-	-	-	-	-	-
1979	194 931	552 662	628 087	-	-	-	-	17 487	625

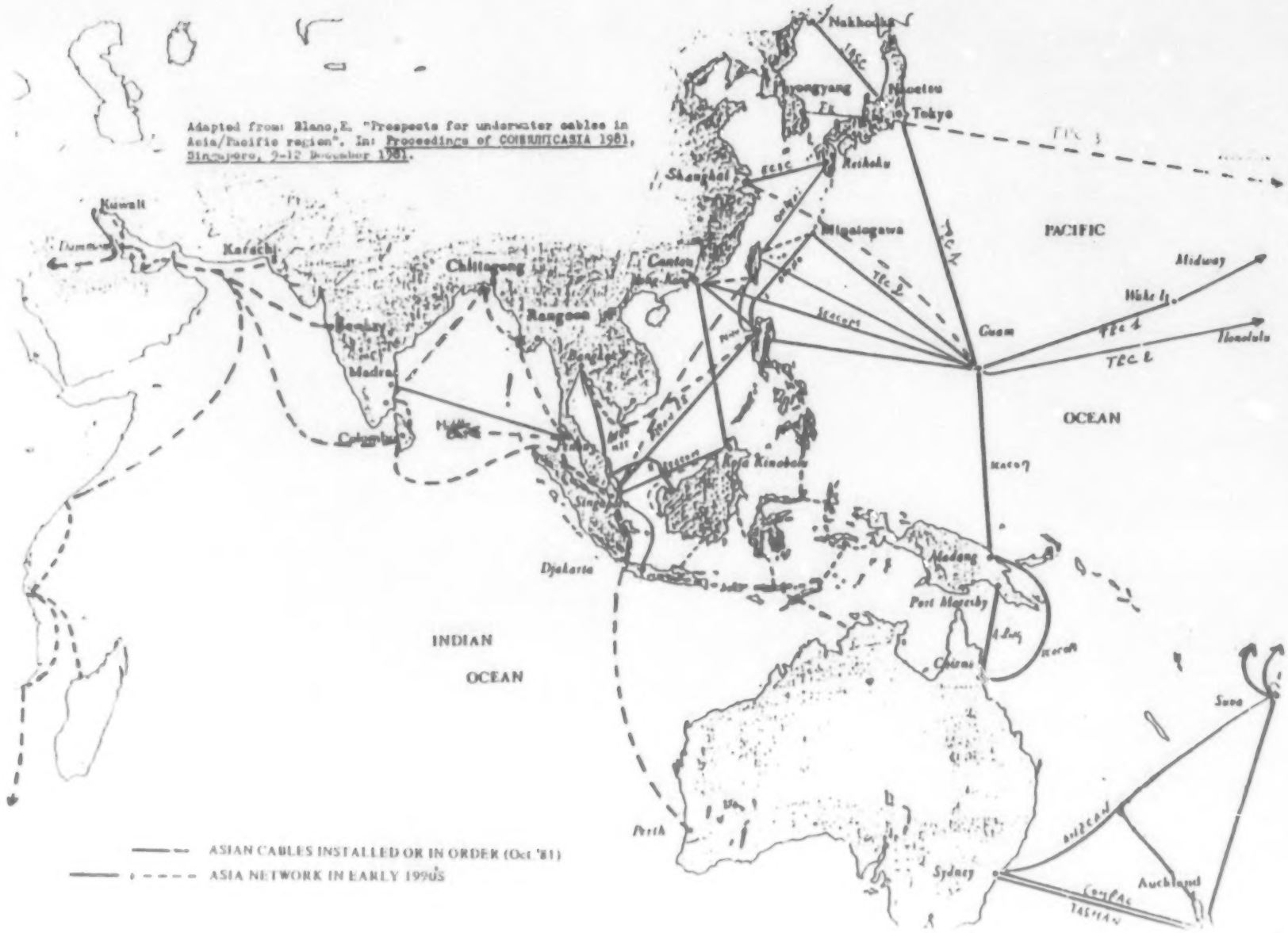
Origin : Year Book of Common Carriers Telecommunications Statistics, 8th edition, Geneva, ITU.

Number of Transponder	TRANSPONDER ALLOCATION FOR PALAPA A (I and II) - 1978-1983
1	Demand assigned 'single channel per carrier' telephony : 333 channels (166 circuits) expandable to 1000 channels (500 circuits)
2	Back-up for transponder no. 1
3	Permanently assigned FDMA telephony : 212 circuits
4	Permanently assigned FDMA telephony : 600 circuits (special leased network-HANKAM)
5	Permanently assigned FDMA telephony : 336 circuits
6	Permanently assigned FDMA telephony : 480 circuits
7	Permanently assigned FDMA telephony : 338 circuits
8	Domestic TV (TVRI)
9	LEASE (Philippines)
10	LEASE (Thailand)
11	LEASE (Malaysia)
12	Occasional LEASE (ASEAN TV)
	FDMA : frequency division multiple access

ALLOCATIONS FOR THE 24 TRANSPONDERS OF PALAPA B (III and IV) - 1982-1990	
PERUMTEL	9
TVRI (television)	2
HANKAM (defense)	1
ASEAN (for remote areas)	
Philippines	3 1/2
Thailand	3
Malaysia	1 1/2
ASEAN TV	1
Back-ups	3
TOTAL	24

Source : Mangoendiprodjo, W.M. PALAPA : a satellite communication for development. Bandung, PERUMTEL, 1981 (supplemented by discussions with PERUMTEL staff).

ANNEX 7 : ASIAN SUBMARINE CABLE NETWORK IN THE EARLY 1980's



ANNEX 8 : GLOSSARY

Acoustic coupler : A device for coupling a data terminal or similar equipment to a telephone line by utilizing sound waves to or from an ordinary telephone handset or equivalent. If the data is to be transmitted as an analogue signal the acoustic coupler must be used with or contain a "modem" (see below).

ALOHA : The technique for assigning satellite capacity in the first experimental packet broadcasting network (operated by the University of Hawaii; several improvements to this technique have since been developed (see section 2.3).

Baud : Unit of signalling speed expressed as the number of signal elements per second. Since a signal element can represent more than one bit, the baud rate is generally lower in magnitude than the same rate expressed in bits per second (b.p.s.)

CCITT : Abbreviation (taken from the French name) for the International Telegraph and Telephone Consultative Committee, the part of ITU which is responsible for setting standards needed for the international interworking of telecommunication services; the coverage of several CCITT recommendations relevant to the present report are listed below under R and X.

Concentrator : A device which accepts traffic from a number of lines and places it on a common line; in the other direction it distributes traffic from the common line (see section 5.4.).

International gateway : Equipment which controls international traffic to and from a telecommunications network (see section 5.4).

ISDN : Integrated services digital network (see section 2.1).

IT -16 : A (non-CCITT) international standard for telegraph channel multiplexing (on the 16th time slot of a PCM frame at 2048 Mbit/s).

Log-in procedure : A procedure (protocol) employed by a terminal user to gain access to a remote computer or to a specific database.

Mesh network (distributed network) : A communication netwotk in which each internode link is backed-up means of at least one path involving other internode links.

Modem (modulator demodulator) : A device which 1) accepts a digital signal and transforms it into a signal suitable for transmission over an analogue channel such as a telephone circuit and 2) receives an analogue signal from a distant modem and converts it back to a digital signal.

Node : A point which is a junction of lines in a communication network. The word is often used to refer to a switching centre (packet switching exchange) in a packet switched data network (see section 2.2).

NPSN : National Packet Switching Network (name used in the present report for the future Indonesian public data network).

PAD (packet assembler and disassembler) : That part of a packet switched network which performs the conversion between packets and a character stream suitable for a simple (asynchronous) terminal.

Packet switching exchange (PSE) : See "node"

Packet switched network : A data network employing packet switching techniques (see section 2.2).

Protocol : A strictly defined procedure for interaction across an interface or through a communication facility.

Public data network : A telecommunication network which provides data transmission services to any public (e.g. public sector, private sector or individual) user (see section 2.1).

R 35 : CCITT recommendation concerning frequency-modulated voice frequency telegraph (FMVFT) equipment with a modulation rate of 50 bauds.

R 101 : CCITT recommendation concerning time division multiplexing techniques for 46 telegraph channels at a rate of 50 bauds. The aggregate bit rate at 2400 bps. can be transmitted either on a telephone voice channel or by higher order time division multiplexing.

R 111 : CCITT recommendation concerning time division multiplexing for a combination of a maximum of 240 telegraph channels at a rate of 50 bauds. The aggregate bit rate can be transmitted either on an analogue primary group or a time slot at 64 Kbit/s of a digital primary group.

Transponder : An independent transmission facility within a communications satellite (see section 2.3).

X 3 : CCITT recommendation concerning PAD functions in a public data network

X 25 : CCITT recommendation concerning the interface between packet mode (synchronous) data terminal equipment and the data circuit terminating equipment (nodes) of a public data network.

X 28 : CCITT recommendation concerning the protocol between a simple (asynchronous) terminal and a PAD.

X 29 : CCITT recommendation concerning the protocol between a synchronous terminal and PAD or between two PAD's.

X 75 : CCITT recommendation concerning the terminal and transit call control procedures and data transfer system on an international circuit between packet switched networks.

X 121 : CCITT recommendation concerning the international numbering plan for public data networks.